# BELL TELEPHONE QUARTERLY

VOL. XVII OCTOBER, 1938 NO. 4

THE BELL SYSTEM MEETS ITS GREATEST TEST

FUNDAMENTALS OF A PUBLIC RELATIONS PROGRAM FOR BUSINESS

TWENTY YEARS OF CARRIER TELEPHONY

WORLD'S FAIRS AND BELL SYSTEM EXHIBITS

AMERICAN TELEPHONE & TELEGRAPH CO. • NEW YORK

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BELL TELEPHONE QUARTERLY

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*A Medium of Suggestion and a Record of Progress*

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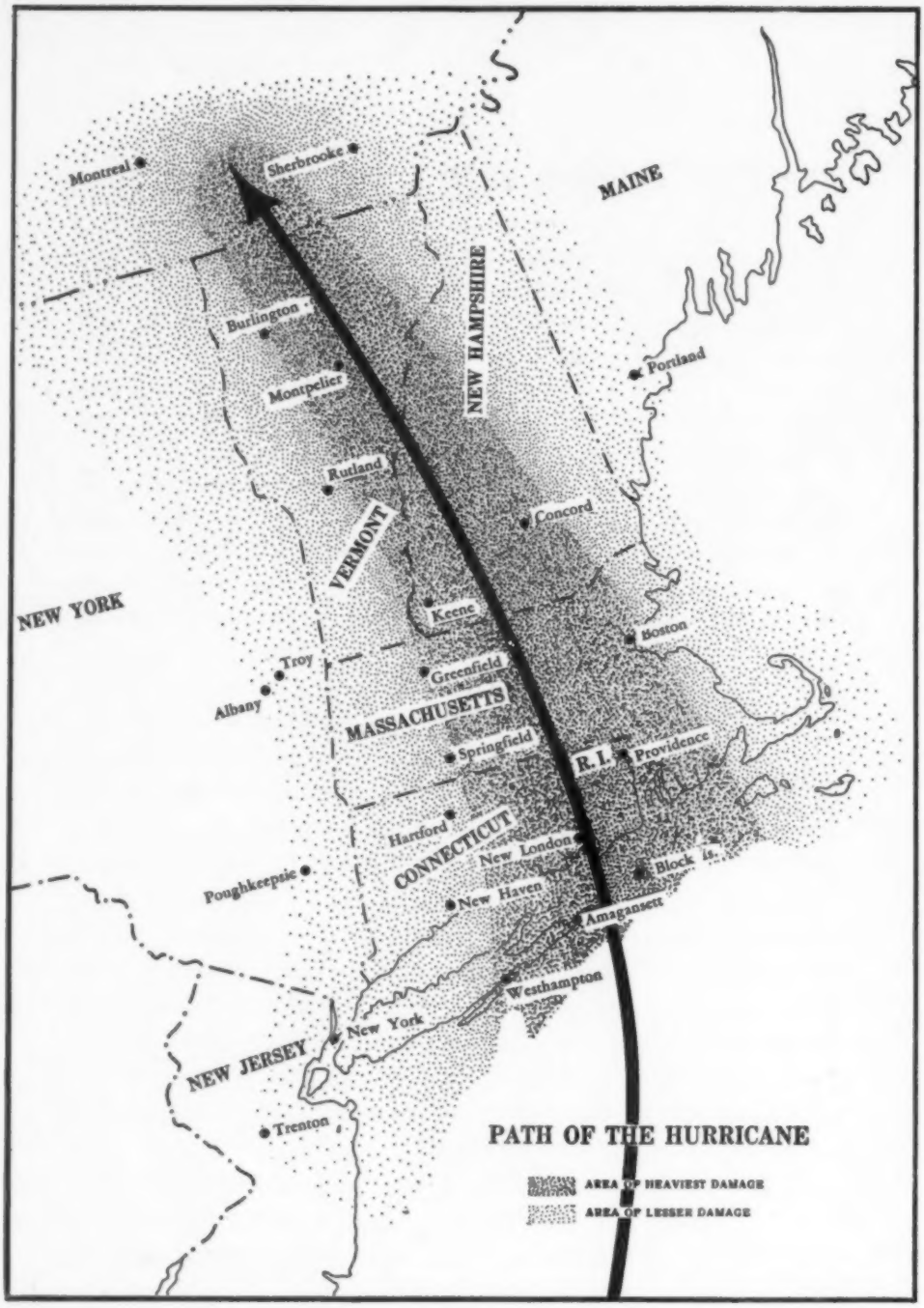
# The Bell System Meets Its Greatest Test

*Editor's note: Again the* BELL TELEPHONE QUARTERLY *recounts the prompt and effective functioning of the Bell System, through its integrated organization, in meeting the challenge of a wide-spread disaster. In previous issues have appeared "Mobilizing for the Fight Against Sleet," January, 1925; "The Telephone's Part in the Mississippi Flood Fight," July, 1927; "The Bell System Fights the Floods," April, 1936; and "Meeting the Challenge of Sleet and Flood," April, 1937.*

*To obtain background for the following article, the author left New York for the area most critically damaged by the hurricane which struck the northeastern states on September 21 as soon as highways were reported passable, and drove through Connecticut, Rhode Island, Massachusetts, the southern part of New Hampshire, and a section of Vermont.*

HURRICANE. FLOOD. TIDAL WAVE. FIRE. These are the Four Horsemen of Destruction which Nature turned loose last month to ride in swift fury across the north-eastern part of this country. Behind them they left stricken some of the most thickly populated and highly industrialized sections of the nation, and some of the most beautiful. While not at any one time and place did all four march flank to flank, their path—whether singly, paired, or three abreast—was marked by loss of life (the toll now approaches 700); by destruction of homes and property; by damage to business and industrial structures, to utility plants and systems, to rural and agricultural areas, to every means of communication. Where went these forces, there devastation never before experienced in that part of the world remained.

There remained, inevitably, a wreckage of telephone plant which confronted the Bell System with the greatest test it has ever been called upon to face: a test of its organization, of its


Montreal
Sherbrooke
MAINE
NEW HAMPSHIRE
Burlington
Montpelier
Portland
Rutland
VERMONT
Concord
NEW YORK
Keene
Boston
Troy
Albany
Greenfield
MASSACHUSETTS
Springfield
R.I.
Providence
Hartford
CONNECTICUT
New London
Block Is.
Poughkeepsie
New Haven
Amagansett
Westhampton
New York
NEW JERSEY
Trenton
PATH OF THE HURRICANE
AREA OF HEAVIEST DAMAGE
AREA OF LESSER DAMAGE

men and women, of its resources of equipment and supplies—of its ability to keep lines of communication open under inconceivably difficult circumstances and to restore the service over a vast territory as quickly as the recuperative powers of a nation-wide System make possible.

The meeting of that test is the story which the following pages try—most inadequately—to tell.

## What Happened In and To Eight States

There was, to begin with, rain. It came down intermittently at first, then steadily, for several days—beginning, in New England and eastern New York, on Saturday night, September 17. Suddenly—unexpected, unforeseen—there were, along the hilly watersheds, floods. Tributaries spilled their overflow into every low place, hurried their bulk of racing water into the bigger rivers of the region, and, almost over night—there was a flood. Strangely, it was the "little rivers"—the lovely New England streams beloved of trout-fishermen—which did the great share of the damage. Throughout this upper New England area, the height of water and the damage done by these lesser streams greatly exceeded that of the record flood of 1936.

By contrast, the two great rivers of New England, the Connecticut and the Merrimac, behaved with somewhat greater decorum. They overflowed far and wide. They flooded low-lying towns and parts of cities. Their high water caused great damage. But—neither came within two to three feet of reaching the crests of their 1936 floods, which were so extremely destructive. And the communities along their banks, many of them, had learned a lesson from their previous experience and were better prepared to cope with the high water.

Meanwhile, and far from all this, trouble of another kind was brewing.

Out somewhere off the West Indies a tropical hurricane came into being. On September 18 the Weather Bureau announced

its birth, predicted its rate of progress in a generally westerly direction, emphasized its severity. Three days later, on the afternoon of September 21, that hurricane, having traveled a path outside all the experience of the Weather Bureau and increasing in violence as it went, struck the north-eastern Atlantic seaboard.

Its center of greatest violence passed over the central and eastern part of Long Island, struck the New England coast in the general area between Saybrook, Conn., and Westerly, R. I., progressed northward over eastern Connecticut and western Massachusetts into New Hampshire, in that state veered slightly to the west across upper Vermont, entered Canada apparently in the region between Montreal and Quebec, and passed thence into the wilderness above—and out of this picture. Sustained wind velocities of from 90 to 120 miles per hour were reported at various points, and at the Blue Hill observatory of Harvard University, just outside Boston, a gust of 186 miles per hour was registered.

This was the path of the *center* of the storm. Its total extent was, of course, widespread. Winds of gale force extended roughly from the northern shore of New Jersey to Cape Cod, along the seaboard, and covered a like area as the storm proceeded north. With them they brought torrential rains to add to the already flooded streams.

It was this wind, this monstrous, invisible power, which did most of the damage over the greater part of the afflicted territory. It unroofed, overturned, demolished people's homes. It seriously damaged substantial structures. It blew down trees. From New Jersey to Maine, that is the characteristic mark of the hurricane: trees down. And, seemingly, every second tree which fell, in its falling tore loose telephone drop wire, ripped through open wire lines, knocked poles down, or bore cable to the ground.

As if not satisfied with what havoc it could create alone, the

hurricane brought with it a tidal wave,* its height variously estimated at from 15 to 30 feet and of force immeasurable, to ravage and inundate the seacoast from Long Island and central Connecticut to the tip of Massachusetts. In many places it left the coast line almost unrecognizable. It completely erased whole shore communities. Wherever its resistless might struck, the tidal wave carried devastation on its crest. Linked as it was with the worst of the hurricane, the conditions which followed its recession are indescribable.

Fire was purely localized tragedy, of course. Springing to life among heaps of wreckage or in wind-shattered buildings, it threatened in several communities, large and small, to become holocaust. In each locality so endangered, the fear of conflagration increased the confusion, the uncertainty, the sense of hazard. From the telephone standpoint, fire peaked higher the traffic load at local switchboards, melted a cable here and there, complicated still further the task of restoration: relatively, minor difficulties in the vast whole of trouble.

That, then, is such picture as hasty words may give of what can happen in and to eight states when, in the course of a few days, they are visited by hurricane, flood, tidal wave, fire.

## Half a Million Telephones Were Silenced

"The hurricane of September 21 in the northeastern states brought the greatest damage to outside plant and caused the largest number of service interruptions in the history of the Bell System." These somber words, amplified later in the same paragraph by reference to flood and tidal wave, open an official report on the situation disclosed by an early survey of the territory. Later information, as received day by day, served not to modify but to intensify the import of that first sentence.

* According to the U. S. Weather Bureau, this was not a true tidal wave but a "storm wave," compounded out of low atmospheric pressure, high tides, the pressure of the wind, and the cumulative power of advancing and receding waves. The effect was that of a tidal wave and it is generally so described.

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey—these are the states affected in greater or less degree. They are served by four Bell telephone companies: New England Telephone and Telegraph Company, The Southern New England Telephone Company, New York Telephone Company, New Jersey Bell Telephone Company. The trunk routes through this region are furnished and operated by the Long Lines Department of the American Telephone and Telegraph Company. Statistics can show only the barest outline, the skeleton, of the story; but they may give some indication of what happened to those companies and in those states.

In New Jersey, 35,000 telephones were out of service. In New York the number was 56,000, of which 30,000 were in the Long Island Area and 15,000 in the Upstate Area. Connecticut's loss was 105,000. In the rest of New England the out-of-service report reached a disheartening total in excess of 300,000. For the two New England companies, the telephones "out" amounted to approximately 25 per cent of their combined total telephones. Numerically, the telephones out of service in the four companies came to about half a million.

One of the most discouraging aspects of the restoration problem was that at certain times and places the number of telephones made working was seemingly almost equaled by the number newly reported "out." The New England Company has record, for instance, of 79,000 stations "out," after the hurricane, because of wires broken and working cables severed during highway clearance operations and the removal of trees from private property. Some days after the disaster, rain seeped into damaged cables and put another 12,000 telephones on the trouble report. Restoration of local service was for a time a Sisyphean undertaking.

Station loss is one measure of the situation. It tells only by implication of the damage to drop wire and to local, toll, and Long Distance open wire and cable. With the first task at

hand that of patching, of running twist, of affording the quickest means somehow, anyhow, by which the messages might go through, there was no time for that sort of count. One revealing figure, however, is that of the Southern New England Company, whose early estimate was that in Connecticut upwards of 3000 separate splices of cable would have to be made. The two New England companies saw immediate need for more than 20,000 poles; the two adjoining companies to the south for another thousand or more.

Electric light and power lines suffered in the same way as did outside telephone plant. Forty-nine out of the Southern New England Company's 85 central offices, for instance, were without commercial power for longer or shorter periods. But because of long-standing emergency preparations, no messages failed to go through solely for lack of power. In some instances where power failure was temporary, the batteries held up. In others, permanently installed emergency gasoline engines saved the day. In other cases, gasoline motor generators and welding machines, arranged for long since against the need, were rushed to the central offices both of the Associated Companies and of the Long Lines Department, sometimes behind the screaming siren of a police motorcycle. More than one central office operated for a week or longer on batteries charged by such emergency apparatus which thundered on, day and night, outside the building.

Traffic, it scarcely need be said, leaped upward to new peaks even as the wires to carry it decreased to half or less at many points and—in some particularly hard-hit communities—practically to zero. Some random notes on traffic—telling of anxiety over loved ones, of the need for help, of reassurance, of the search for information on the part of individuals, public officials, relief organizations, of all the questions and answers and bad news and good which catastrophe creates—may show something of the situation at the switchboards.

Local traffic in New York City, Westchester and suburban New Jersey was far above normal immediately following the hurricane, as it was in such places as New Haven, Hartford, New London, Providence, Worcester and Boston. Just the opposite was the case in Littleton, Keene, Peterboro, Winchedon, Narragansett and some 170 other towns and small cities which were isolated and at which a large percentage of the telephones were out of order. Here the problem was that of handling emergency conditions rather than heavy traffic. All service was terminated in several towns when the central offices had to be abandoned because of damage to them by flood.

Long Lines traffic in New York City reached an all-time high on Friday, September 23, when 53,600 calls were recorded—an increase above normal of 40 per cent. Toll traffic in places suburban to New York was nearly double the normal average for several days.

Long distance traffic in New England was double normal in most places. In Boston, on the day after the hurricane, 42,600 calls were recorded, also an all-time high and 130 per cent over normal. Due to the heavy traffic and the loss of toll circuits, completion in Boston reached a low of 52 per cent on September 23.

The A, B, and C cables between New York and Boston—the "underground" backbone of Eastern seaboard communication —failed on Wednesday morning (before the hurricane, be it noted) when a normally well-behaved stream went berserk and demolished a bridge at Atwoodville, Conn., a few miles above Willimantic, which carried the cables across. A section of an important route between Norwich, Conn., and Providence, R. I., was practically demolished, as was the New Haven-Providence line which runs along the shore, mainly by falling trees. The Springfield-Albany cable and the most important cable route entering Vermont were severed when a bridge over the Connecticut River at Chicopee Falls was carried away. Lines entering Vermont from New Hampshire were also down. So

many cities and towns in these two states were temporarily without service that both were for a time virtually "off the map," telephonically speaking. A bridge washed out at Wareham, Mass., and severed cable communication with the western part of Cape Cod.

## Meeting the Challenge of Catastrophe

That summary can do little more than suggest the crisis in New England's telephone service which one day in late September brought. To relate in any detail the ramifications of the whole problem of reconstruction and recovery, to do more than touch upon the infinity of obstacles faced and overcome, to attempt to portray the universal response of employees, in the true spirit of service, to the challenge of catastrophe, is beyond the limits of space—and time—of this article. As in every disaster, there are certain events, certain circumstances, which stand out sharply focussed in the foreground. To include a few of these here may serve to make the picture more vivid, although still far less than complete.

Every telephone man and woman can picture without difficulty the immediate reaction of the Bell System men and women throughout the entire endangered territory. Soon as trouble became apparent, operators off duty and those on leave returned to their central offices, reported, took places at the switchboards—all as a matter of course. Former operators volunteered everywhere, were welcomed and put to work. Operators due for tours of duty braved floods, dodged falling trees, struggled against the hurricane, to reach their posts. Very many arrived late, buffeted, water-soaked, exhausted—but they arrived. These soldiers of the switchboard gave no thought to time, refused to go home, snatched a few hours' rest and again took up their cords. Calmly they worked as buildings shook in the wind, as great trees crashed around them, as menacing waters rose nearer.

So, too, their brother workers gave of themselves without limit. Plant forces knew no hours. Beside them worked commercial employees—salesmen, business office representatives, any who could be of help. Test desks were key points; there all who knew the work responded to the need, and for days and nights the posts were manned to the limit of the equipment. Engineers took to the field with the plant crews. Paymasters with cash in hand set up offices at central locations. Men from the Accounting Department went out to relieve foremen and supervisors of time-consuming detail. Many a subscriber was startled to receive a masculine response to a request for "Information."

Nowhere, nor at any time, was there hysteria, confusion, or discouragement. This was the worst thing that had ever happened in New England—they knew that, these telephone folks; but though their shoulders might be bowed under double loads, their chins were up!

Many telephone buildings served as havens of refuge from terror and peril, especially for people in the smaller towns, and also were put to temporary service as Red Cross stations and as headquarters for relief organizations.

New London, Conn., was desperately crippled. A large brick armory next to the telephone building was blown to pieces. Fire followed the hurricane and tidal wave and raged unchecked to within a block of the central office, where a telephone truck was kept ready to batter down the back fence if at the last moment flames blocked all other avenues of escape.

Providence, R. I., located at the head of Narragansett Bay, was hardest hit of all of New England's big cities. Not only was the force of the hurricane severe; in the low-lying commercial and industrial section, the flood waters of the tidal wave rose six to eight feet above sidewalk level, surging through the first floors of stores, office buildings—all the important central structures of a metropolis. The resultant havoc

was beyond description. All normal activities were completely suspended for several hours, and the task of pumping out basements continued for days.

When the Connecticut River rose to its highest crest on record, in 1936, water filled the basements of the two main telephone buildings in Hartford, Conn., and flooded the first floor of one to a depth of several feet. Batteries and associated power equipment were drowned and telephone service in much of the city was disrupted for several hours. The Southern New England Telephone Company subsequently moved the power plant upstairs, reinforced and waterproofed the basement of the building nearest the river and built removable water-tight bulkheads for all its ground-floor doors and windows. When the Connecticut's rising waters again threatened the building, business-office records were moved to upper floors, and the bulkheads were put in place and caulked. The river rose to within about two feet of its 1936 level—and thus several feet above the window-sills on the ground floor—but the bulkheads held it out. Telephone damage in Hartford last month due solely to high water was, in comparison with 1936, slight.

When the bridge at Chicopee Falls, Mass., succumbing to angry waters, took important cables down stream with it, various means were attempted to get a line across the torrent. These failing, the Long Lines men on the job appealed to the Coast Guard. Soon there arrived by airplane from Rockaway, L. I., a Chief Boatswain's Mate and, with him, a Lyle gun—the device used to shoot a line to a shipwrecked vessel. Standing on the bridge approach, he loaded, aimed, fired. The projectile easily cleared the 700 feet of turbulent river, landed safely on the other side; the light line it carried was intact. With this, rope was pulled across, to be followed in turn by wire and then by strand. Soon linemen were riding this to patch in twist for temporary circuits. By morning, a new section of cable, placed and spliced, was supported high above the

roaring river. The Coast Guard performed a similar service at a smaller stream near Occum, Conn., using a shoulder gun instead of the cannon type.

There was river trouble in upper New York State too, as well as in New England. In addition to the smaller streams which caused typical damage, the flooded Mohawk River provided opportunity for ingenious and courageous maintenance work west of Amsterdam. When the approach to a bridge which carried New York-Buffalo cables was washed out, construction forces during one night erected supporting fixtures for a catenary span, and, when the strand was in place, again crossed the river tying the cables to it.

Radio telephone service played an interesting and important part in bridging gaps in telephone service.

The ultra-short-wave radiotelephone service between the New England Company's radiotelephone station at Green Harbor, Mass., and Provincetown afforded the only telephone communication between Cape Cod, from Provincetown to Hyannis, and the rest of the world. Portable short-wave equipment provided for emergency use after the 1936 floods was used to establish telephone communication between Block Island and the mainland. Other portable equipment, some of it flown up from Florida, provided a link between Boston and Keene, N. H., and other points in that state. These emergency radio circuits carried a heavy load of traffic, which averaged better than 50 messages a day—and reached peaks of more than 100—until physical circuits were restored. Over the Keene-Boston radio link a call was successfully completed to San Bernadino, Cal.

To the handling of long distance calls into the affected area an important contribution was made by the Long Lines Traffic Control Bureau at New York. This bureau has the dual responsibility of keeping track of the condition of all telephone circuits in the northeast and of redistributing the traffic in such a way as to keep the flow even over the various routes. This

may mean detouring calls around crippled or congested lines; often it means anticipating breaks or a sudden flow of calls. At all times it calls for a skill and alertness to act instantly on every development.

The minute a traffic problem arises—as it did so quickly and so greatly on September 21 and the difficult days thereafter—this bureau goes on 24-hour duty. On this occasion its staff saw little rest; but, thanks to the skill they had developed and the foresight with which their arrangements were made, there was not a working line into New England which did not carry its full share of the heavy load that flowed through that region.

## Help Rolls In from Near and Far

Invaluable as were the countless temporary and emergency measures which were everywhere undertaken—often before the tempest had ceased its attack or high water appreciably subsided—there yet remained the tremendous requirement of repairing and rebuilding hundreds upon hundreds of miles of communication lines, of restoring hundreds of thousands of telephones to service.

This was the staggering task, the unexampled challenge, which faced the Plant Departments of the Bell companies in New England, New York, New Jersey. To it they summoned their resources of man-power, knowledge, skill. Grimly they accepted the challenge Nature had flung at them—but with calm confidence.

Regular plant forces of these companies swung into action at the first signs of trouble. That goes without saying. Then, as what had actually happened to outside plant in New England was realized, plant forces there were quickly augmented: by former plant men, now in other departments, drafted back to their old jobs; by former employees who responded to the call; by contract gangs; and, of course, by local men hired temporarily for the urgently necessary tasks of tree removal, general cleaning up, and such work as can be performed by un-

skilled labor. Thus increased, the plant forces of the New England Company totaled 6,000; of the Southern New England Company, 1,900—seventy-nine hundred men actually on the firing line, working from dawn to dark—and often longer—to restore service to more than 400,000 telephones in six states. That was their job. They went about it. They could do it, and that they knew. But—it would take time.

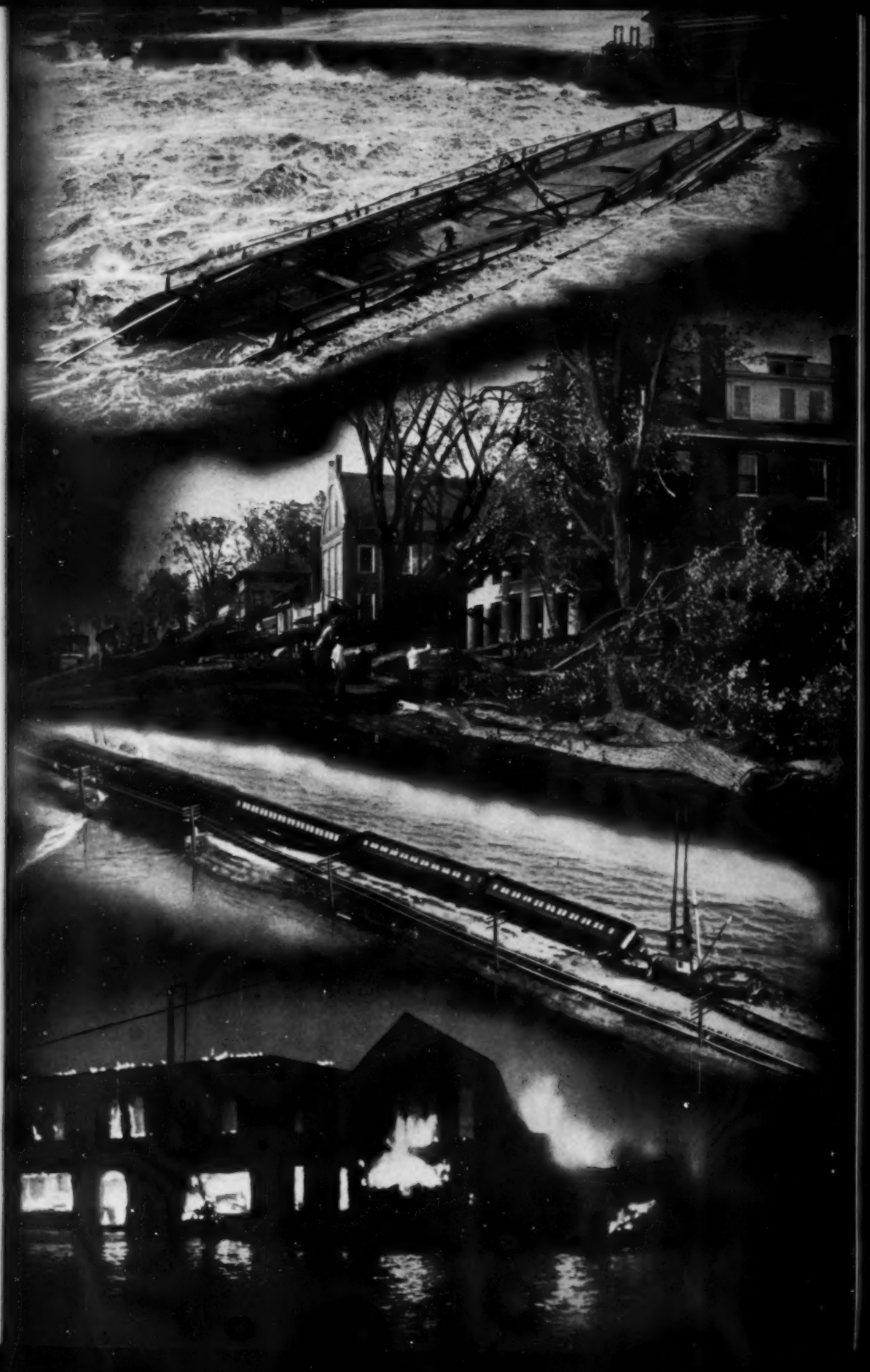
Meanwhile, a whole disaster-smitten population was frantically trying to get messages through. As always under such circumstances, telephone service was needed in proportion as it, too, had suffered damage. That need could be met—service could be made available to more places and to more people—in shorter time if these men of New England could have help.

In the hour of New England's need, that additional help came. The Bell System swung into concerted action!

Men and materials: those were the vital requirements of the New England and Southern New England companies. Almost at once there appeared on the highways and the wrecked streets of their territories, telephone trucks—singly or highballing in convoy behind police escort—bearing the license plates of distant states. Men: all that could be used. Men: trained in Bell System methods, familiar with Bell System equipment, needing no instruction but only to be shown the task. Men—and their own trucks, their own tools, their own foremen and supervisors. Bell System men!

And, that the record be complete, it should be noted that 42 operators from Philadelphia, Cleveland, Detroit, were brought to New York by train and flown thence to Boston, where they took their places beside their sister operators at the Long Distance switchboard.

At the first word of disaster, the Western Electric Company slipped into well-oiled emergency gear: 3-shift, 24-hour operation. The Hawthorne and Clearing Works in Illinois, Kearny, Point Breeze, the New York headquarters, the local distributing houses—particularly the Boston, New Haven, and Brook-



*On the preceding page—*

FLOOD: *The Connecticut River takes a highway bridge down stream at Chicopee Falls, Mass. (Associated Press Photo).*

HURRICANE: *A typical New England scene after the storm's passing—Main Street in Windsor, Vt.*

TIDAL WAVE: *Its aftermath on the main New York-Boston railroad line near Stonington, Conn. (Associated Press Photo).*

FIRE: *Burning over a large area in New London, Conn., it added its terror to that of hurricane and tidal wave. (Photo courtesy Dr. Robert T. Henkle.)*

*Floods in central New England made many highways impassable, as here at Waterville, Mass. (Int'l News Photo).*

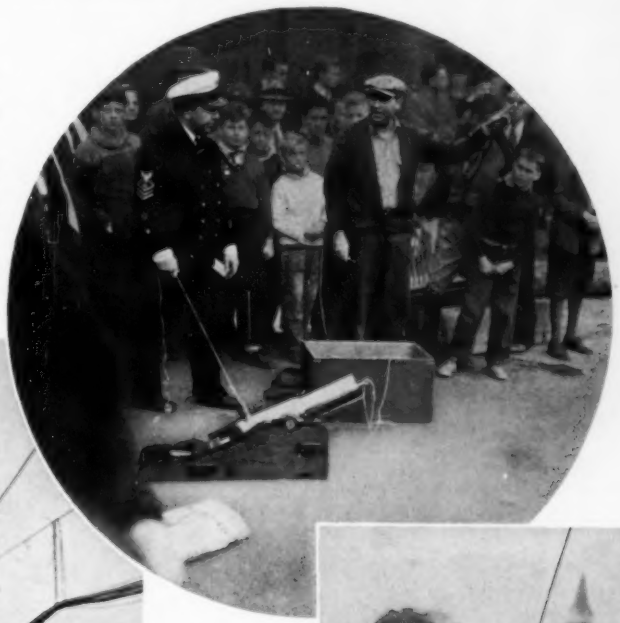
*This view toward the front door of the central office at Orange, Mass., shows why the operators had to quit their positions.*

*This coursing torrent was once a street in Ware, Mass., where overflowing of the Ware River isolated the town for several days.*

*After the great flood of 1936 in Hartford, Conn., bulkheads were built for all doors and windows of the telephone building nearest the river. The picture at the right shows how they kept the water out last month; the small picture above shows boatmen patrolling the outside of the building, with water several feet above the first floor windowsills.*

*This flood sweeping across River Street, Brookfield, Mass., illustrates why much of central Massachusetts was isolated for a time.*

*In circle: Coast Guard Chief Boatswain's Mate about to fire Lyle gun to carry line across the Connecticut River at Chicopee Falls. Lower right: Pulling a heavier rope across the river after the Lyle gun's light line had cleared the 700-foot flood. Below: Long Lines Department lineman riding a suspension strand above the Connecticut as a result of the Coast Guard's assistance. Note temporary twisted pair already suspended across the river.*



*Trees, power lines, telephone cables in tangled confusion in Hartford, Conn.*

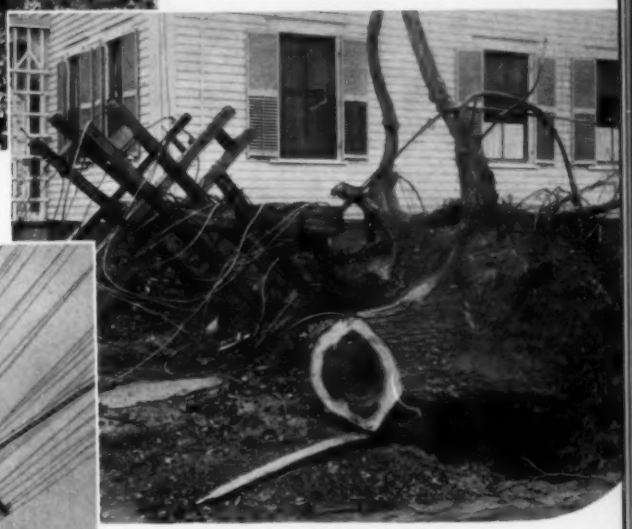
*Most of this barn blew through the telephone line at Wapping, Conn.*

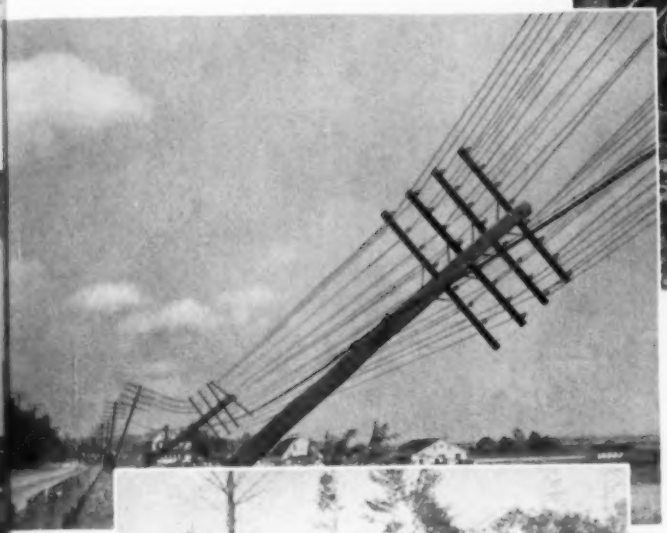
*A scene at Southbridge, Mass., which was typical of thousands of similar situations.*

*Trees fell, poles were borne down, over a vast territory. This destruction is in the Bronx-Westchester Area of the New York Telephone Company.*

*A national guardsman on duty before the smashed windows of the New England Company's business office at Newton Corner, Mass.*

*Typical of what the hurricane did to outside plant are the pictures on this page: Left, at Brookfield, Mass.; Below, at Stoneham, Mass.*





*Where there were no trees, pole lines sometimes survived intact the fury of the wind, as in the case of this line at Rutherford, N. J.*

*Terminal box, cable junction, guy wire, and pole tip all crashed here, in Brookfield, Mass.*

*Destruction of a pine forest—and a telephone line—near Peterboro, N. H.*

*New England street scene.*

*A 3-foot section of tree trunk plummeted through the roof of the Deep River, Conn., central office and bounced up to the top row of dial equipment.*

*The steeple of this Willimantic, Conn., church crashed through a local telephone cable.*

*Front of the Southern New England Company's central office at Middletown, Conn., after the hurricane.*

*Telephone cables supporting a huge elm at Manchester Center, Conn.*

*The hole the t*

*Above: This is all the tidal wave left of a row of substantial cottages at Hawks Nest Beach, near Lyme, Conn.*

*Left: This motorboat was made fast to a telephone pole at Stony Creek, Conn.*

*The fire engine at the left is pumping out manholes in Providence, R. I., while the generator in the foreground is providing emergency power for the New England Company's central office.*

*Debris of outside telephone plant in Shinnecock Canal near Westhampton, L. I., after the wave had receded.*

*This vessel's anchor parted a submarine telephone cable, her anchor chain wrecked a house, and her bow came to rest against an aerial cable beside the Taunton River in Massachusetts.*

*Above: What the tidal wave left of a summer colony at Westhampton, L. I.*

*Fire added its horror to the flood at East Brookfield, Mass.*

*Flames melted telephone cables, adding to the general destruction of plant, as here at New London, Conn.*

*What hurricane and tidal wave didn't demolish, fire did, in this section of New London.*

*At this emergency headquarters of the New England Company in Boston, the Plant, Traffic, Commercial and Engineering Departments coordinated their efforts to provide emergency service for hospitals and doctors, for fire and police departments, for governmental and civic bodies, etc.*

*W. H. Harrison, Vice President & Chief Engineer of the A. T. & T. Co. (right), conferring with Long Lines District Plant Superintendent J. M. Desmond in eastern Connecticut on September 23.*

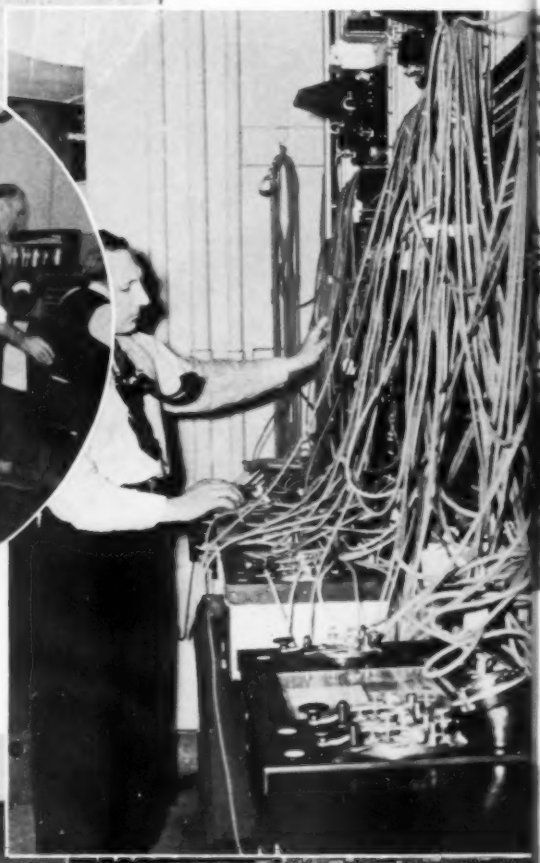
*Headquarters of the Installation Department in Providence, R. I., directing restoration of service under difficult conditions.*

*Night conference in Western Electric Company's distributing house at Watertown, Mass. Without electric light and power, all emergency supplies were carried and loaded by hand.*

*The test desk in New Haven would normally have one man on duty at midnight. This picture was taken at that hour on the night of the hurricane.*

*Below: Patching cords at the New England section of the Long Lines telegraph testboard in New York City immediately after floods and hurricane made necessary the rerouting of circuits.*

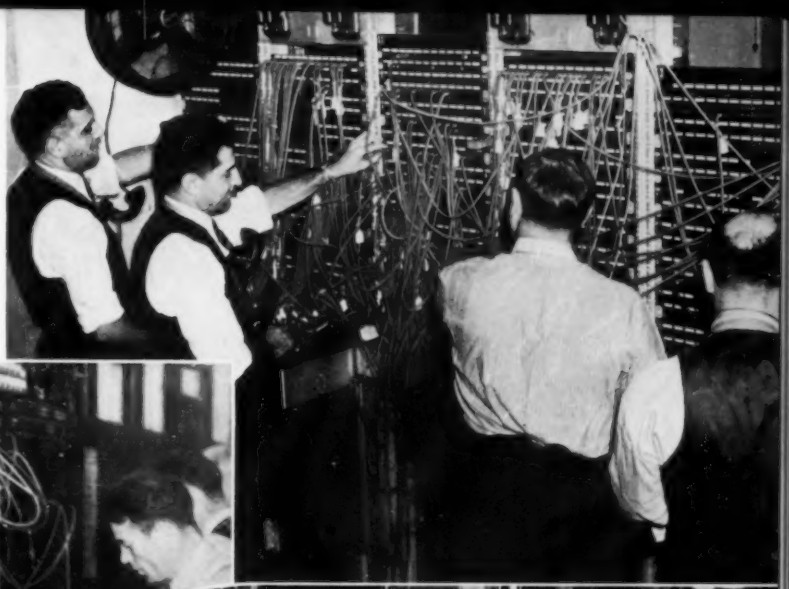
*The central test desk at Providence, R. I., after hurricane and tidal wave struck.*

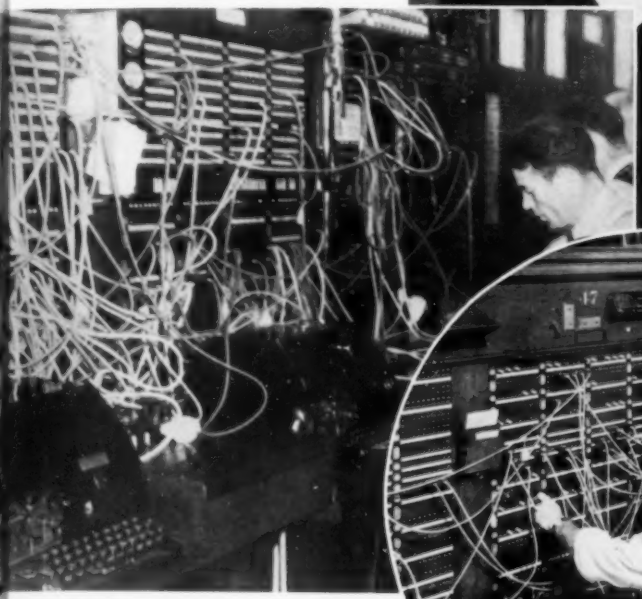


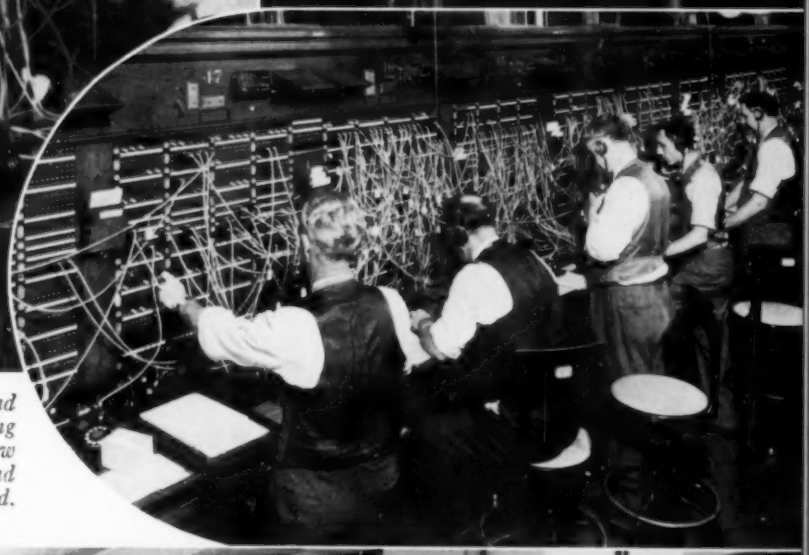
*The Long Lines traffic control bureau in New York, nerve center of long distance service, as calls mounted to their peak.*

*More patches at the Long Lines telegraph testboard in New York City.*

*Below: These patches at a Connecticut long distance telephone testboard show how messages were routed through on circuits still working.*







*Right: "Detours" being found for telephone calls at the Long Lines telephone testboard in New York City at the peak of demand for circuits into New England.*

*Every one of the 110 positions at this block long toll switchboard at Hartford, Conn., was constantly filled for several days following the disaster.*

*Each white plug at this switchboard at Keene, N. H., shows a line out of service. After the hurricane, only 50 out of 1853 lines were working.*

*Below: Long distance operators from Philadelphia about to leave Newark Airport for Boston. Other operators were brought on from Cleveland and Detroit and flown from Newark to assist at the Boston long distance switchboards.*

*Left: Messenger lights and flashlights furnished the only illumination at the Providence, R. I., long distance switchboards as operators struggled to handle, over reduced circuits, the largest number of calls ever received.*

*Below: Operators at Middletown, Conn., worked by the light of kerosene lamps as a frantic public rushed to make calls on the night of the hurricane.*

*Right: Trucks from the central and western divisions of the New York Company's Upstate Area pause in Albany to pick up their crews, who had come ahead by train.*

*Above: New York Company Upstate crews stop to refuel in New Haven, on their way to eastern Connecticut.*

*Splicers and helpers of the New Jersey Bell Company leaving Grand Central Terminal in New York for New England.*

*The first contingent of New Jersey Bell construction crews crossing the George Washington Bridge on their way to help their fellow workers in the east.*

*Out-of-state licenses show that these construction trucks traveled many miles before parking for the night in New London, Conn.*

*Right: Bell of Pa. trucks passing through New Haven en route to Connecticut shore towns three days after the hurricane. Below: More Pennsylvania trucks in Danbury, Conn., the same day.*

*Right: A Chesapeake & Potomac Company crew on the job at Jamaica Plain, Mass.*

*Two C. & P. men from Alexandria, Va., getting the lay of the land from a Southern New England Co. man at Madison, Conn.*

*This convoy of telephone trucks, bearing western license plates, is en route through Pittsfield, Mass.*

*Ohio Bell trucks arrive at Palmer, Mass., in the rain. Below: other Ohio Bell trucks at Dayton ready for shipment by rail to Danbury, Conn.*

*Left: Indiana Bell linemen and splicers detraining at New Haven, Conn., en route still farther east. Below: Unloading Indiana Bell trucks at New Haven prior to starting overland for the New England Company's territory.*

*"Bedding down" an aerial cable truck for the rail journey east.*

*Above and right: Trucks and men of the Michigan Bell Company after unloading in Hartford, Conn., on the way to Massachusetts.*

*Below: At Northampton, Mass., as thirty-seven trucks with crews of the Indiana and Illinois Bell Companies stopped on their way east.*

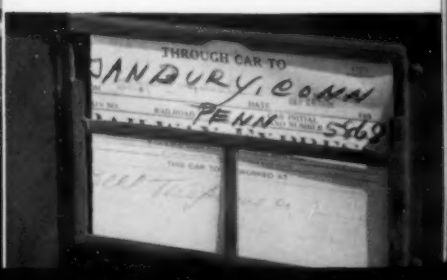
*Aerial cable trucks of the Illinois Bell Company waiting in Chicago to be loaded on a special train for New England.*

*An aerial cable truck being secured in a gondola for the ride to the devastated area.*

*Above: Men and equipment of the Northwestern Bell Company at Keene, N. H. Left: Loading Northwestern Bell trucks at Omaha, Nebr., for the long trip.*

*Right: Southwestern Bell Company trucks being loaded in St. Louis, Mo., with Vermont their destination. Below: Southwestern Bell men waiting for their special train to carry them to New England.*

*Why the trucks got there as soon as the men.*



*A truck convoy leaving the Kearny, N. J., Works of the Western Electric Company at night with reels of lead-covered cable for the storm-wrecked area.*

*Cable yard at Providence, R. I., showing a small part of the tremendous quantity of cable which Western Electric shipped into New England.*

*Circle: Loading cable reels at the Kearny Works for quick transit to New England.*

*The cable dock at Western's distributing house at West Haven, Conn., was a scene of intense activity following the disaster.*

*From Western Electric's Boston distributing house many hundreds of miles of wire and cable were shipped into the storm-stricken area.*

*Upper right: Cable delivered in readiness to be placed across the Connecticut River at Chicopee Falls, Mass., as soon as the poles are ready to support it.*

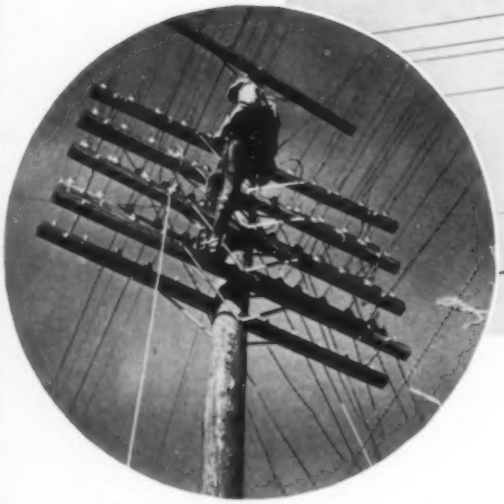
*Trucks were thus identified to speed their journey.*

*Apparatus, too, was swiftly but carefully loaded at the Kearny Works.*

*Leading trucks of a Western Electric cable convoy on the road to Boston.*

*Untold miles of twisted pair were quickly run to restore temporary links in important circuits. This scene is in Eastern Connecticut.*

*A Diamond State Co. lineman goes to work on a battered cable at Westbrook, Conn.*



*Splicing temporary twisted pair into an important open wire toll route east of New London, Conn.*

*Clearing open wire of fallen pines between Peterboro and Dublin, N. H.*

*A Pennsylvania Company splicer on the job at Westbrook, Conn.*

*Right: A new pole goes up in Melrose, Mass. Below: A New Jersey Bell Company man at work in Mystic, Conn.*

*This new cable restores the Brookfield, Mass., section to communication with the rest of the world.*

*This splicer in Providence, R. I., is drying out cables while the manhole is still partly flooded.*

*A New York Company crew removes a fallen tree from a cable near Selden, L. I.*

*Using a tree as a telephone pole to provide emergency service for the Melrose, Mass., Hospital.*

*A Long Lines lineman rides temporary strand where the Mount Hope River took out important New York-Boston cables.*

*A Pennsylvania Bell crew doing restoration work at Narragansett pier, R. I.*

*Below: A New Jersey Bell crew preparing to string a new cable at Mystic, Conn. Lower left: A Chesapeake and Potomac crew at work in Melrose, Mass.*

*Right: Long Lines men splicing temporary twisted pair at an important cable break at Atwoodville, Conn.*

*Above: Restoring service at Bogota, N. J.*

*In the wake of the storm at Saybrook, Conn.*

*Below: A Pennsylvania Bell gang on the job at Madison, Conn.*

*Below: Splicers at work at the Atwoodville Long Lines cable break.*

*Left: Work goes on far into the night. These Southern New England men are making temporary repairs on a New Haven-New London toll cable at Lyme, Conn.*

*New York Company construction crews resetting poles along the Montauk highway near Westhampton, L. I.*

*Right: A new submarine cable to replace one under the Taunton River in Massachusetts which was severed by a dragging anchor. Circle: Control station near Keene, N. H., for the short wave radio circuits which temporarily bridged the gap to Boston.*

*Pennsylvania B men pulling t gether in and f New England.*

lyn houses—the important suppliers, all were co-ordinated in one effort to one end: to get the supplies into New England and Long Island where they were needed, as they were needed, and all that were needed. They did!

Movement of men and supplies into New England was greatly hampered by the interruptions to railroad operation and by the carrying away of bridges, the washing out of highways, the omnipresent blockade of fallen trees. Plant crews, whether local or of other Bell companies, were often forced to take roundabout routes; were at times entirely debarred from certain areas. Western Electric supplies moving in by truck encountered the same obstacles. Western also shipped large quantities by private car, by airplane, and by boat.

That plant crews rolled into New England from as far south as Virginia, from as far west as Arkansas and Nebraska reveals at once two things: the urgency of the situation and the extent of the response. In the second week after the disaster, there were at work in New England more than 2300 trained men loaned, with their 615 motor vehicles, by 14 companies:

| Companies | Crews | Construction and Repair Men | Foremen, Supervisors, Service Men and others | Motor Vehicles |
|---|---|---|---|---|
| New York | 156 | 417 | 85 | 128 |
| Rochester Tel. Co. | 3 | 14 | 4 | 4 |
| New Jersey | 56 | 187 | 40 | 47 |
| Penna. & Diamond State | 129 | 317 | 62 | 124 |
| C. & P. (Washington) | 13 | 39 | 4 | 6 |
| C. & P. of Baltimore City | 19 | 68 | 15 | 15 |
| C. & P. of Virginia | 18 | 51 | 8 | 14 |
| Ohio | 92 | 224 | 47 | 106 |
| Michigan | 32 | 104 | 34 | 38 |
| Indiana | 38 | 104 | 24 | 26 |
| Illinois | 26 | 84 | 17 | 32 |
| Northwestern | 40 | 153 | 35 | 33 |
| Southwestern | 32 | 97 | 25 | 29 |
| Long Lines | 14 | 66 | 13 | 13 |
| TOTAL | 668 | 1925 | 413 | 615 |
| *Sent to* | | | | |
| New England Co. | 416 | 1267 | 306 | 336 |
| So. New England Co. | 252 | 658 | 107 | 279 |

Crews from the eastern states generally came into New England overland in their own trucks. Those from the more distant companies came by train as far east as the railroads were then operating—the men in Pullmans and the trucks in freight cars routed as express—unloaded their equipment, and moved forward to the scene of action under their own power. Several groups came as units, including in their number clerks, automotive maintenance men, supervising foremen, and—in some instances—division or state construction superintendents.

Men must have materials to work with. The following statistics show the enormous quantities shipped by the Western Electric Company up to October 14, most of which, of course, was delivered in the early days of the emergency—and all of which, with a few negligible exceptions, was standard, inspected material, meeting the Bell System's rigid specifications. For purposes of comparison, the entire System's average monthly demand is also shown.

| | *Storm Orders Shipped to October 14* | *1938 Average Monthly Demand For Bell System* |
|---|---|---|
| Lead Covered Cable | 607,000,000 cond. ft. (3,797,000 lin. ft.) | 1,206,000,000 cond. ft. (3,804,000 lin. ft.) |
| Drop Wire | 53,613,000 lin. ft. | 27,195,000 lin. ft. |
| Prepared Cotton Sleeves | 16,632,000 | 10,036,000 |
| Strand | 6,910,000 lin. ft. | 3,426,000 lin. ft. |
| Cable Rings | 3,211,000 | 1,322,000 |
| Copper and Steel Sleeves | 2,956,000 | 963,000 |
| Copper and Steel Line Wire and Ties | 2,380,000 lbs. | 2,020,000 lbs. |
| Pole Line Hardware | 2,039,000 lbs. | 1,178,000 lbs. |
| Drop Wire Clamps | 535,000 | 460,000 |
| Lead Sleeving | 494,000 lbs. | 273,000 lbs. |
| Bridging Connectors | 491,000 | 113,000 |
| Solder | 132,000 lbs. | 115,000 lbs. |
| Paraffin Wax | 110,000 lbs. | 45,000 lbs. |
| Pine Poles | 21,800 | 28,500 |
| F Type Cable Terminals | 21,700 | 10,000 |

## What Men-and-Supplies Can Accomplish

Men and supplies! That is the combination—plus, of course, all that is implied in the phrase *Bell System*—which has come out on top. In the six states of New England, where more than 400,000 silent telephones had been the challenge, all had been restored to service in a fortnight save where restoration and rebuilding were particularly difficult. Every telephone is back in service, every town reconnected into the nation-wide telephone network, long since. Most of the crews from beyond New England have gone home again, rolling away to west or south, bearing with them the gratitude of the people of New England and the hearty "So long, fellows—and thanks a lot!" of the men by whose sides they had worked in many a city and town, on many a highway and country road.

Not all the crews who came into the wrecked area have yet left, however. As this is written, some crews, who can be spared a while from their home territories, are helping to put some of the original emergency repairs into better shape, in preparation for the thorough and necessarily longer operation of permanent restoration.

It is an inspiring spectacle, this co-ordination of effort of every branch of the Bell System toward one end. Associated Companies, Western Electric, A. T. and T. General and Long Lines Department, the Bell Laboratories—their resources of every sort are vast, their spirit is indomitable, their teamwork is unbeatable.

## Public Recognition and Appreciation

That the public comprehended the magnitude and the gravity of the telephone companies' situation, and that it appreciated the valiant and well-organized efforts toward rehabilitation of the service, were made evident by many commendatory statements, both privately by individuals and pub-

licly by the press, by officials, and by civic bodies. Such approval was, of course, most heartening to those on the battle-front of restoration.

Public expression of approval is most readily typified by editorial comment in newspapers, many of them far from the scene and untouched by the disaster. Excerpts* from a few are representative of many others:

From the Franklin, N. H., *Journal Transcript:*

We take a good deal of pleasure in paying tribute to the remarkably efficient service rendered during the 'emergency period' this week Wednesday night, particularly, by the local telephone exchange. Operators must have worked at fever pitch, but they were calm and collected and decidedly helpful. . . .

The earth was a howling wilderness and all hearts were struck with a new, strange fear. Excessive rains had seemed enough to worry about before the cyclone struck. The weather bureau predicted a night of heavy rain. In the midst of all this discomfort and uncertainty, the fact of quick service given as matter of factly as if all was well with the world, was solid comfort to the customers. . . .

From the Keene, N. H., *Evening Sentinel:*

Though the hurricane, and accompanying flood, which devastated Keene was 10 days behind us the arrival in this city Sunday night of 189 expert telephone men and a great fleet of heavily loaded trucks from Iowa must have reminded the people of Keene that reinforcements are continuing to arrive and go into action in the work of rehabilitating the utilities wrecked by the storm. As the crew from the west arrived we must have recalled that famous song we have often heard sung, the lilt of which rings in the ears of every person who may have heard it from throats of the sons of Iowa—the song that men from the land "where the west begins" sing—"Iowa, Iowa."

"Editorial paragraphs" from the same paper:

The sight of the telephone trucks rolling along the highway and into Keene made one contrast that picture with the pictures of the trucks loaded with uniformed, armed soldiers rolling into Czechoslovakia.

* Occasional statistical inaccuracies do not affect the cordial tenor of these editorial expressions.

Here the army of occupation came ununiformed and on an errand of mercy and succor. The faces of the men were jolly and friendly, not set with a belligerent tenseness. And the men got out of their trucks ready to set right to work at the task of restoring a service to the public.

People in Keene are getting a new and large respect for the telephone company because of the prompt way the company brought in men from all over the country to get the service restored in the Keene-Peterboro district.

We thought it was pretty smart business when the men began to arrive from Maine and New Jersey and New York and went right to work.

But we were even more impressed by the sight of 27 trucks and eight or ten light autos rolling into Keene from Rutland, Vt., last night after debarking from a two train special which brought them east to Rutland from Chicago.

When you think of men coming here from Iowa, Nebraska and Minnesota to put our service in order, it makes you feel pretty good.

Times like the present show the value of a national tie-up in the utilities, a tie-up that can bring immediate concentration of experienced men and ready equipment on the spot in short notice.

Further, it shows the value of standardization in details of mechanics of the particular utility involved and the standardization of equipment to handle repairs.

From the Nashua, N. H., *Telegraph:*

Probably no public utility suffered more damage, sustained the loss to equipment and its business, and is having a greater problem in the matter of rehabilitation than the New England Telephone Company. Five hundred or more lines out of order in this city is only a small proportion of the more than two hundred thousand of its phones out from northern Vermont to Cape Cod. We take our hats off to the crews of linesmen in this city working day and night to get the service restored. . . .

Notable also is the vast resources of men and material which were rushed into this stricken area. Three thousand men and women experienced in telephone work from New York, Pennsylvania, New Jersey, car loads of cable, millions of feet of wires, poles by the thousand, and so on. Really a marvel of modern day will, energy and resource.

From the Hartford, Conn., *Times:*

Two things, possibly among many, are noteworthy as telephone construction workers from as far away as Delaware and Virginia reach Connecticut to help repair the flood and hurricane damage.

That it was necessary to summon aid from so far away affords one measure of the extent of the destruction. Few people need to be told that the telephone plant was hard hit. That is evident on every side—in city streets and on the State highways. Practically every tree that came down brought wires with it, either serving a single building or a whole community.

The wonder is not that it was so difficult to communicate between cities, or that so many homes and business places were without telephone service, rather, the degree to which that fate was escaped.

Also, the aid from afar illustrates an advantage of having a single, nationwide telephone system. There are other advantages, of course. Rival companies in a town or in a state would, certainly, be a nuisance. Existence of the Bell System throughout the country serves the convenience of telephone users generally. The present incident illustrates what unification means in time of disaster. . . .

From the Detroit, Mich., *Free Press:*

The dispatch of 150 expert telephone workmen by the Michigan Bell Telephone Co. to the hurricane-stricken area in New England is an instructive illustration of how intimately and intricately modern means of communication have tied up all parts of the United States.

A great telephone organization in one section of the country can extend more than sympathy to another section with the wires down. . . .

From the Allentown, Pa., *Morning Call:*

The value of the unification of the utility systems of the country in very large units and the existence of working agreements between the various units is well illustrated in the immediate response that was made by Allentown to the plight of the people of New England.

When news of last week's disaster was received in this city and other cities where the Bell Telephone Co. operates phone systems, there was no question as to what should be done. Almost instantly, highly trained men were sent out of this city to the stricken areas. Simultaneously from scores of cities, similar forces of men with the necessary tools and equipment were on their way to put the telephone house of New England in order.

There did not have to be long questioning as to the responsibility of the men nor the responsibility of the phone services for the men's work and materials. The unification of the system assured that the men would be

paid or their companies would be reimbursed for their services, the use of their equipment and the materials which they put into their work. . . .

From the New York *Journal of Commerce:*

. . . The most difficult task was faced by the telephone companies affected. At the height of the storm, fully 500,000 telephone stations in New England were out of service, and telephone trunk lines were destroyed throughout the territory. Today, service has been restored to every community affected, and work is rapidly going on to connect individual telephones once again.

This vast work of reconstruction has required not only the 3,278 men who constitute the regular construction and maintenance staff of the New England Telephone & Telegraph Co., but also 450 former employes who volunteered for service during the emergency and 2,385 employes of other telephone companies affiliated with the American Telephone & Telegraph Co., many of whom have come from west of the Mississippi. Fully equipped and arriving in 1,500 trucks, these groups of workers from other telephone companies could immediately join in the work of rebuilding New England's telephone system only because the parent company had effected standardization of equipment and methods in the telephone industry throughout the country.

An important contributing factor was the fact that an associated manufacturing company, the Western Electric Co., has specialized so long in providing materials and equipment for the Bell System. Western Electric has shipped more additional material into New England in the past fortnight than was ever made necessary by a natural disaster in the past. . . . The remarkable record of the telephone company, and similar aid given their subsidiaries in New England by parent public utility and telegraph companies, constitute an emphatic demonstration of the value of the holding company in maintaining public service in the face of natural disasters.

From the New York *Times:*

Organized society, like the human body, cannot recover from surgical shock with a shattered nerve system. Society's nerve system, of course, is communication. When the recent hurricane struck this region it put 51,000 telephones out of commission in this State alone and silenced at least 450,000 more in New England. On the lines that remained in service the demands were doubled.

The effort of the telephone companies to restore normal communication vividly illustrates the value of integration on a national scale. The first need, obviously, was to meet the tremendous pressure on the lines which remained open in the stricken areas. Calls immediately went out to former operators on company lists within the damaged districts. Then, almost before the great wind had stopped blowing, experienced long-distance operators were rushed by plane from Cleveland, Buffalo, Philadelphia and Washington to Boston, Hartford, Providence and other centers.

The next urgent need was to open disrupted lines. Sister companies in sixteen States undertook the organization of telephone relief. The New York company had a serious problem of its own with the devastation on Long Island, but it sent 601 men into New England. New Jersey, Pennsylvania, the District of Columbia, Maryland and a half dozen other States all contributed their share. The Southwestern companies sent 122 men from Oklahoma, Arkansas and Missouri, and the Northwestern companies loaned 188 from Iowa, Nebraska and Minnesota. Altogether 2,352 linesmen from other States entrained for New England.

They came in 596 fully equipped trucks. These were loaded on flat cars and the railroads delivered them as near the path of the hurricane as possible. They went the rest of the way over washed-out and tree-clogged roads on their own power.

Some of the difficulties of the crews seemed almost insurmountable. . . . But the severed lines must go up, and thousands of tired linesmen are still unwinding their restoring reels through smashed and tangled forests.

From the New Haven, Conn., *Register:*

In a regional dispatch from Boston on post-hurricane conditions one paragraph reads as follows: "The relief task was hampered by failing telephone communication. The New England Telephone and Telegraph Company, which at one time lost a quarter of all its phones, reported 44 communities still were cut off and 185,000 telephones were out of order. Two thousand linesmen were on hand from as far away as Virginia."

That is easy to believe from the number of fleets of out-of-state telephone repair trucks that have been seen eastward bound along the highways in the past few days. A good many persons have stopped to watch the passage, under motorcycle police escort, of New Jersey Bell System and Virginia caravans loaded about to the wheels with coils of wire and other repair supplies, in a hurry to get into action in the stricken areas.

The effort is plain. So is the blessing of standardized operations, of

far-flung co-operating organizations, developed efficiency whose fingers can reach far out beyond local areas and state lines for trucks, materials and men which and who can be spared in the gigantic campaign to get essential communication restored at the earliest possible moment. . . .

These gratifying expressions of a realization of what a unified communication system does in reality mean to the nation are an appropriate stopping-point for an account which has tried, in many more words, to tell the same story.

JUDSON S. BRADLEY

# Fundamentals of a Public Relations Program for Business

*A paper prepared by Arthur W. Page, Vice President, American Telephone and Telegraph Company, for presentation and discussion at the Seventh International Management Congress held in Washington, D. C., September 20th, 1938.*

IN THIS discussion I am assuming that public relations are designed to give a business a good reputation with the public, establish it in the public mind as an institution of character and an institution which functions in the public interest. I am not including a discussion of publicity, advertising or other activities that have a purely sales purpose.

Anybody who does business with the public is in a public business and subject to regulation by the public in many ways —by a great variety of laws, from those to do with incorporation or partnerships to fair trade practices and blue sky legislation; by various forms of public supervision; by the public's giving or withholding patronage; and by praise or blame from political leaders, radio commentators and the press. The public lays down the rules for its service, partially in laws and partially in public opinion, which at any time may be made into law. The task which business has, and which it has always had, of fitting itself to the pattern of public desires has lately come to be called public relations.

There are obviously a great number of ways of handling the problem. I am going to suggest one method, not because I think it is better than many others, but so as to have a concrete outline before you.

The first thing in this program is to have the management of the business write out a statement of policy. This is equivalent to saying to the public: "We should like to serve you and

we offer you the following contract which we think would be fair to all concerned and mutually profitable."

No one can write out such a document without thinking over the company's responsibilities to the public, as a purveyor of goods or services, as an employer, as a taxpayer, perhaps as a trustee of the public's investments, and so forth. It might occur, also, that a document of this kind which the management would be proud to sign, when literally applied to the business, might not fit in all particulars. This immediately brings up the question whether the business or the policy was wrong and which should be changed. In other words, this writing out of a policy is a device for making the management take the time to study seriously and carefully the relation between the public and the business, to see whether the business has public approbation and whether it ought to have it—to see itself as nearly as is possible as the public sees it.

The second part of the program I suggest is that, a policy having been established, some machinery be set up to see that two things happen—(1) that the business does not deviate from the policy by inattention or neglect, and (2) that the details of the policy be changed to fit the changing public desires. The machinery to do this is ordinarily called the Public Relations Department.

A company can, of course, work out a policy and set up machinery to keep it revised without a public relations department as such. But keeping attuned to the public wishes may be so vitally important that it seems but a matter of insurance to detail some one to spend all his time on that job. As knowing the public is not an exact science, the gentleman detailed to the job cannot answer questions with the precision of an engineer, or even within the latitude taken by legal counsel. But by constant attention, study and experience he can learn some things and he can see that the problems concerning the public get the attention they deserve from the rest of the management.

However, to do this effectively he will have to be a part of the policy-making councils of the company, for it is of the essence of the daily conduct of affairs. It cannot be an isolated function. Even though a company has set up a positive program and has a realistic philosophy about its relations with the public, it must still be prepared to meet new aspects of public opinion which arise at any minute. It may be questioned by one group for having too much debt, and another for not having enough; by one group for having too many college graduates, and another for not having enough; at one time in our history the public would have censured a company for building ahead in a depression, at another for not doing so; sometimes there is criticism of lack of salesmanship, and sometimes of overselling. In other words, the public is a somewhat whimsical master. To keep in tune with it means eternal vigilance in watching its moods.

Not long ago I saw a review of a book about Governor Hutchinson, British governor of Massachusetts just before the Revolution. The review stated that the people of Massachusetts had convicted Governor Hutchinson of treason against the state which they anticipated forming. That process of reform, so strikingly stated in the review, has been exactly the process of reform that the American people have continued to practice on both individuals and business ever since. When the public gets an idea that certain business practices should be changed, it picks out a victim, tries him and convicts him under the law it intends to pass. The job of business is to guess what practices the public is really going to want to change, and change them before the public gets around to the trial for treason.

So much for the policy side of the public relations program I want to present to you.

There is another side. Most of the day-by-day relations of business with the public are not conducted by management but by the other employees. Salesgirls, salesmen, receptionists,

repairmen, telephone operators—these are the people who largely represent business to the public. A company may have the best overall public policy in the world in the minds of management, but if the spirit of it is not translated into acts by those who represent the company in contact with the public, it will be largely discounted.

To make any policy effective it would seem to me that the contact employees must be given an understanding of it so that they can be reasonable and polite. In order to be reasonable a person must know the reasons for what he does. If a customer objects to something and is told that it is a rule of the company and nothing more—well, that seems pretty arbitrary. And yet, if the employee does not know the reason for the rule, he can't explain it. Generally speaking, I am sure that public relations are improved pretty much in proportion as the employees in contact with the public understand the reasons behind company policy and practices. And, likewise, the process of getting an understanding of these things is likely to develop better personnel.

And along with this kind of reasonableness and an integral part of it, is politeness. I mean by this, as near unfailing courtesy as human nature allows, plus a genuine desire to make the company a friendly and helpful institution. This means giving employees some latitude and encouraging initiative. No routines and instructions can fit all cases. Employees who know what the objectives of the routines are can safely depart from them in exceptional cases to the great benefit of public relations.

It takes time and money to inform all contact employees of the reasons behind routines and about the fundamental policies of the company, and about anything else which they are likely to be asked by the public. Yet without adequate knowledge to answer, they cannot make the company appear reasonable and it is more difficult for them to be polite and helpful. To have such knowledge spread down through the

ranks of an organization means that from the foreman up to the top management, all supervisors must look upon the process as one vital to the success of the business. Being reasonable and polite to the public must be done by the company as a whole and cannot be done for the company by a special department. It is a way of life.

Perfection, of course, is impossible in anything, but a rather considerable degree of reasonableness and politeness ought to be easily achieved because these qualities are natural to most people, if not diminished by the pressure of routines, techniques and ratings on other aspects of the job. But if it is clear that politeness and reasonableness are also rated high by the management, they ought to come back to their proper place. Moreover, the employee himself has a better life if his contacts with the public are pleasant and he is justified in having a better opinion of his job and a greater satisfaction in it if all who mention the enterprise of which he is a part—and an understanding part—speak well of it.

In discussing politeness and reasonableness, I do not mean something employees can be trained to put on like a cloak. I am not talking about stage management. I am talking about character—running a business so that the more the employees know about it the better they feel about it, and running it with people who know what they are doing, have a pride in their profession and want that profession held in high esteem by other people because it deserves to be.

A business that recognizes a broad responsibility to the public and takes its employees into its confidence will probably maintain a fairly analytical state of mind at the top, for there will be many questions coming from the employees and from the public through the employees. And these will be most useful straws to tell which way the wind of public opinion is likely to blow.

Under this program I have set up as a basis for your discussion, you have—

1. A top management that has analyzed its overall relation to the public it serves and is constantly on watch for changes in the public desires.
2. A system for informing all employees concerning the general policies and practices of the company.
3. A system of giving contact employees the knowledge they need to be reasonable and polite and the incentive of knowing that those qualities count in pay and promotion.
4. A system of getting employee and public questions and criticisms back up through the organization so that management may know what the public thinks of the business.

The main emphasis of this program is a manner of conducting a business. Along with this goes frankness in telling the public about the company's operations. Much of this will be done by the contact employees, but much of it must be done in other ways—by advertising in newspapers, magazines, on the radio, by official company statements, speeches and many other ways. I shall not discuss the techniques of advertising and publicity except to state that their function in public relations is to tell the public as much as it will listen to of the policies and practices of the company which make up the contract under which it wishes to serve the public.

This very question of publicity is an interesting example of the changing viewpoint of the public. Twenty-five years ago the complaint against big business was that it was secretive. No one knew what were its policies and practises or what it was doing. There were demands that various aspects of business be made public. This tendency has continued, but of late, if business has not only made the facts available, but by advertising and otherwise got public attention to them, there has been a disposition to object to this as propaganda. There is, of course, a question of propriety and wisdom in

the kind, degree and methods of publicity and on this the public's verdict is as final as on any other subject.

Publicity is an important part of public relations, but in business as in most human affairs, what you do is more important than what you say. It is always possible to make a good statement on a good set of facts, but no more in business than in politics can you fool all the people all the time, and if you expect to stay in business long, an attempt to fool even some of the people some of the time will end in disaster.

The final set-up of the program then is a management alive to its public responsibility, an informed, reasonable and polite personnel, and procedures for informing the public—in other words, an organization made up of many people, which, wherever it touches the public, acts like a wise and considerate individual.

I think you all will agree that the public is a whimsical master. It seems as if all of it never thinks alike at any one time and it never seems to think alike twice. And yet there are certain currents of thought that appear to be more or less constant.

Most people dislike arrogance and are afraid of too much power in others. They, therefore, fear size and monopoly, for big things are often powerful and monopoly is often arrogant. Moreover, they suspect things they do not understand. The consequence is that, practically speaking, business is confronted by the public with a "show cause" order why it should be big. In order to justify size it must be prepared to demonstrate that size is in the public interest in service, economy or some other way. It must be able to demonstrate that big size can be as reasonable and polite as little size. If business wants to be big, it must be able to show that its size is justified in public service. And this brings me back to the point where I began—that every business, big and little, should be able to explain the contract under which it expects to serve the public.

Business is the means of producing the things men live by —the necessities of food, clothes and housing, our entertainment, our luxuries. It is the essence of life and the most useful profession of mankind. The men who do it are the players of the game. The lawyers, the doctors—men of the so-called professions—interpret rules and tend the players. Yet these professions have worked out a relationship to the public, a code of conduct for themselves, and a basis for high morale. They have made their contract with the public. Businesses, not I think en masse, but each one separately, have the same thing to do. Public relations, in this country, is the art of adapting big business to a democracy so that the people have confidence that they are being well served and at the same time the business has freedom to serve them well.

The less confidence the public has in big business, the less freedom the public will give big business. And as you restrict its freedom, you restrict its ability to serve.

It is, therefore, to the interests of both that there be established a state of confidence concerning the relations between big business and the public. Can there be established such a state of confidence? How effective can our public relations be? I have a belief that they can be very much higher than we have yet attained or than most people believe is attainable. You hear a great deal of discussion about the relations of large corporations with the public in which the phrase occurs—"Oh, well, they are attacking this corporation and that, or this or that utility, for political reasons." That is offered very often as an excuse. But it is not a valid excuse. The actual fact is that big business has to meet the political test. The political test comes down to this. If the reputation of big business is good enough with the public, no one representing the public —whether in press, politics or any other capacity—will be hostile to it. Because of the ordinary human suspicions of size, big business will always be closely scrutinized. It will have to be a better citizen than if it were smaller. It will have

to be good enough to have public confidence. Many people feel that there isn't a possibility of getting to such a state. But certainly there is no reason to believe that good public relations are impossible until business, by and large, has put the same thought and effort on the subject that it has put on research, production and selling.

ARTHUR W. PAGE.

# Twenty Years of Carrier Telephony

TWELVE Telephone Channels on a Single Cable Pair! Sixteen Telephone Conversations on an Open-Wire Pair! Hundreds of Telephone Channels on Special Conductors Called Coaxials! Such statements have appeared frequently in the last year or two and in all cases the answer to the question, "How is it done?" is the same, namely, "Carrier Current Systems."

These remarkable achievements are the result of many years of development work extending back almost to the beginning of telephony itself and involve not one but a very great number of inventions. Early in the electrical communication art the idea occurred to many inventors of transmitting more than one message over a single pair of wires. These first inventors, of course, experimented with telegraphy as nothing was then known of telephony. In fact Bell himself was engaged in such experiments when he invented the telephone. They called it harmonic telegraphy in those days and not "carrier" for tuned reeds were used for generating the different messages and harmonizing reeds for separating the messages at the far-end of the circuit.

Although the attention of Bell was diverted from his original study of harmonic telegraphy to the problem of practical telephone transmission, others continued the work and later conceived the idea of multiplex telephony as being the next step. Articles were published discussing the possibility of multiplex telephony as early as the year 1886 but not until about twenty years ago did a practical carrier system materialize. Since that time, however, its application has become extensive. More than 700,000 miles of carrier telephone channel are already being operated in the Bell System, constituting more

than 20 per cent of the total mileage of telephone toll circuits of 100 miles or more in length.

## Basic Principles of Carrier Telephony

The basic principles of the carrier art were well established before the year 1900 by many inventors, including Professor Pupin, John Stone-Stone, Hutin and LeBlanc. Articles were published or patents obtained which described detail methods of carrier transmission. These methods included means for identifying individual telephone messages by combination with frequencies above the voice range, transmitting several messages over a single line and unscrambling them at the far-end of the circuit. The identifying frequencies are called carrier currents, mixing them with the voice currents so as to enable the individual message to be identified at the far-end of the circuit is called modulation, and the corresponding restoration of the original voice frequencies after their separation is called demodulation.

These processes can be easily understood by comparison of the ordinary telephone circuit with the carrier circuit. At the top of Figure 1 is shown a simple telephone circuit consisting of a transmitter, a line and a receiver. The battery at the left causes a direct current to flow through the transmitter. When the transmitter is subjected to sound waves produced by the voice it varies the direct current in such a way that the voice-produced waves are superimposed upon the direct current flowing in the transmitter circuit. The coil shown prevents the direct current from reaching the line but the variations are transmitted over the telephone circuit and are utilized in the receiver for setting up corresponding vibrations in the air which produce audible sounds. If the battery in this circuit is replaced, as shown in the lower half of the figure, by a generator of high frequency carrier current, the voice waves impressed on the transmitter would cause corresponding variations in the amplitude

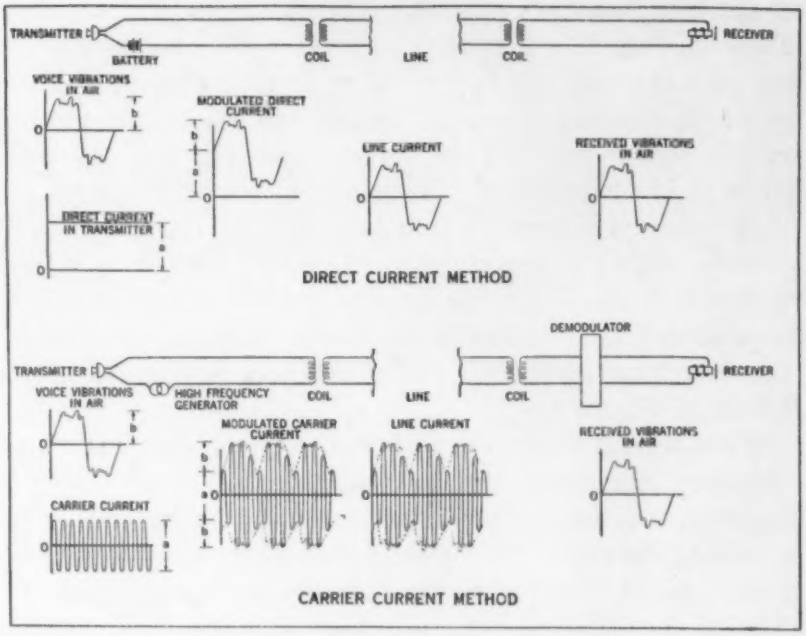



FIG. 1. MODULATION AND DEMODULATION

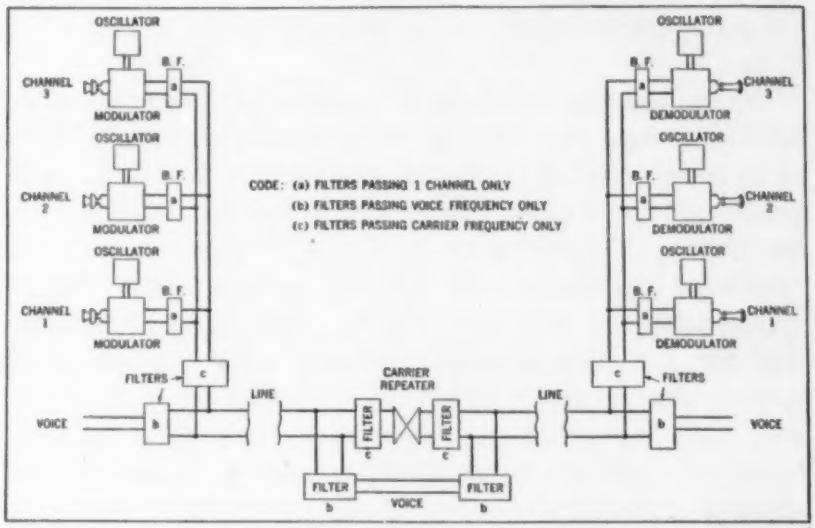



FIG. 2. SCHEMATIC 3 CHANNEL CARRIER SYSTEM

of the high frequency current. This is known as modulation. These varying high frequency currents would pass the coil and out onto the line. It is interesting to note that an ordinary telephone receiver connected to the line would not produce audible sounds provided the carrier frequency was above the limits of the human ear. However, if this varying high frequency current is properly transformed at the receiving end by a device called a demodulator which functions in a reverse manner to a modulator, the original voice frequency would be restored and result in audible sounds in the telephone receiver. The corresponding carrier transformations are shown at the bottom of Figure 1.

When several carrier channels, each using a different carrier frequency, are mixed together on a single line as shown in Figure 2, it is necessary to provide means for separating the individual channels. In the early days of harmonic telegraphy it was possible to separate the channels by tuning, either mechanical or electrical. In telephony, a wide band of frequencies is required to encompass the harmonics of the voice. At least a 2500 cycle band is needed to include the important voice frequencies which extend from 200 cycles to above 3000 cycles.

When these bands of frequencies are acted upon in the modulator of a carrier system, the entire band is effectively shifted in its position in the frequency spectrum, its final location depending on the frequency of the carrier current supplied to the modulator. This is shown in Figure 3 where several voice bands are modulated with different carrier frequencies and transmitted over the line together. The three carrier channels and the voice channel constitute a band about 14,000 cycles wide. At the receiving end it is necessary to divide this wide band into parts corresponding to the original messages by means of devices which select the band of frequencies corresponding to each single channel and reject the frequencies of the other channels. The tuned circuit which was satisfactory

for the narrow bands of telegraphy could not be used in telephony and other means had to be found.

After the bands are separated, each band is mixed in a demodulator with a carrier frequency corresponding to that used in its own modulator at the sending end of the circuit. This combination in the demodulator results in the restoration of each band to its original position in the voice part of the spectrum as shown in the right hand side of Figure 3.

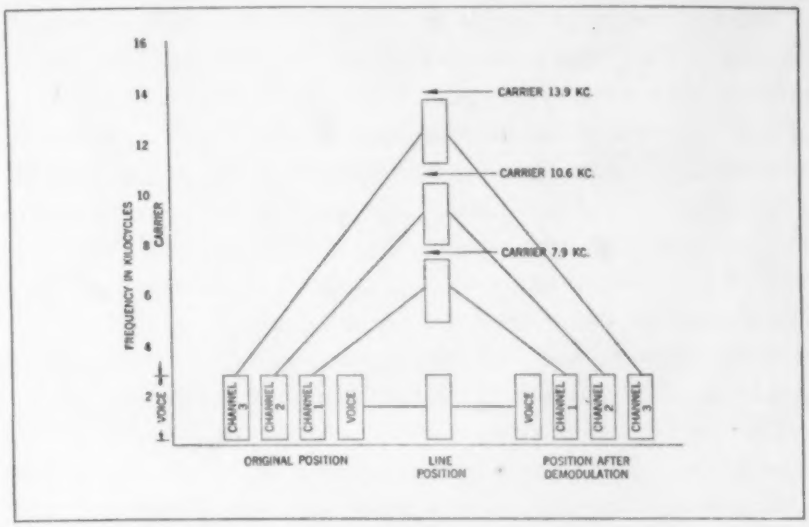



FIG. 3. TYPICAL CARRIER FREQUENCY TRANSFORMATIONS

## EARLY LIMITATIONS

The limitations of the available instrumentalities for modulation, demodulation and separation in the formative period of carrier development greatly hampered inventors in reducing their ideas to practical form. They realized they needed stable generators of high frequency currents, better modulators than the telephone transmitter shown in the simple analogy above, and for multiplex operation more satisfactory methods of separating the carrier current bands of different messages

at the far-end of the circuit. It was not until about 1915 that the development of the vacuum tube and the invention of electrical filters made it possible to devise a workable carrier system suitable for application to the regular telephone service. Vacuum tubes had, of course, been invented several years before, but not until that time had they been developed to a point where they were of practical use in telephony, as evidenced by the completion of a transcontinental line in that year.

The vacuum tube in addition to being useful as an amplifier provided a means of producing carrier currents uniformly and cheaply. The interconnection of the output and input of a vacuum tube results in oscillations that continue at a frequency determined by the constants of the circuit to which it is connected. Also the versatile vacuum tube can be used as a modulator or a demodulator depending upon the circuit connections which are employed. The invention about this same time of the band filter by G. A. Campbell, which enabled specific bands of frequencies to be separated from other frequencies, was the last link which was needed to complete the development of a practical carrier telephone system.

The availability of these devices greatly stimulated development activity on carrier telephone systems, with the result that a commercial installation was made between Pittsburgh and Baltimore in 1918 after various laboratory set-ups and field experiments. This first system provided good telephone channels but was somewhat crude in appearance, considerably more expensive than present systems and occupied a much larger space than the modern product. Development work went on from this first installation, however, making few changes in fundamentals but refining and improving the system until now we have cheaper, more compact and more reliable types of equipment. The large carrier telephone development of the Bell System would never have occurred if these cost reductions and improvements had not been made.

Even after the apparatus and circuit design had been made practicable by the vacuum tube and filter developments, there were many other problems to be solved chiefly in connection with the lines. The facilities of the Bell System at that time had naturally been built to provide good voice frequency transmission and many limitations developed when an attempt was made to use them at higher frequencies. For instance, loaded lines as then designed would not transmit the higher frequencies at all, and even on non-loaded open wire lines the voice

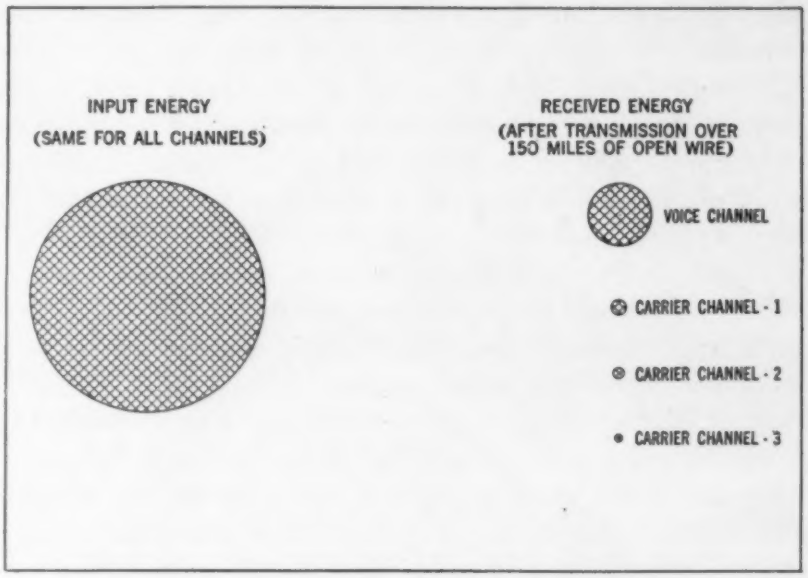



FIG. 4. COMPARISON OF SENDING AND RECEIVED ENERGY

currents in their elevated position in the frequency spectrum diminished much more rapidly than when they occupied their usual position in the lower part of the spectrum. This is illustrated by the chart numbered Figure 4 which shows for each of the four channels the relative amounts of energy received at the distant end of a typical line with equal inputs at the sending end. This meant that repeaters had to be pro-

vided more frequently for the carrier channels than for the voice channels. It is for this reason that the schematic drawing Figure 2 shows a carrier repeater between the terminals, while the voice currents pass over the line without amplification.

Other transmission effects are also exaggerated at the higher frequencies. For instance, crosstalk between pairs is much more severe at the higher frequencies, requiring more frequent transpositions to reduce it to tolerable values. Where the same carrier frequency is used in both directions of transmission, the interaction between the opposite directional channels becomes so severe that it was usually found desirable to utilize different frequency bands for the two directions in the same manner that two-cable pairs are used for opposite directions of transmission in ordinary four-wire cable circuits. Similarly, small pieces of cable in the open wire lines, such as frequently occur at river crossings or other similar locations, were found to constitute serious obstacles to carrier transmission, while at voice frequencies they were relatively unimportant. This problem of transmitting carrier currents through unavoidable sections of cable was solved by the development of a special type of loading which required loading coils to be located in manholes every few hundred feet along the cable instead of every 6,000 feet which is customary for long toll cables operated at voice frequencies. For cable longer than a mile or two the cost of this closely spaced loading became an important factor. With the extension of the carrier technique to toll cables, studies showed that no loading and more repeaters were preferable both for economic and other reasons. Actually the carrier system now used for toll cables employs non-loaded pairs and a 16 mile repeater spacing.

## Successive Types of Systems

A brief review of the successive types of carrier systems used in the Bell System may serve to illustrate the type of problems

which have been encountered and overcome during the course of development of the dependable, high quality carrier systems which are available today. The first carrier system which was installed in 1918 between Baltimore and Pittsburgh was known as the Type A system. This was a four-channel system with a spacing of 5,000 cycles between the carriers of the individual channels. The same frequencies were used in both directions of transmission, requiring that hybrid coils be used to provide the separation between the two directions of transmission in the same way as had been done previously in two-wire repeater operation. The carrier frequencies at the two ends of the circuit were synchronized by a special narrow band channel in addition to the four speech carrier channels, thereby wasting a portion of the useful frequency spectrum. Oscillators in the early days were so unstable that independent frequency generators at the two ends of the circuit could not be kept in synchronism any other way. Figure 5 is a photograph of a complete 4-channel Type A carrier terminal. It will be noted that this equipment was not mounted on relay racks, such as are now ordinarily used for central office apparatus of this nature, but consisted of a line-up of small apparatus bays approximately a foot square and about eight feet high. About twelve of these small racks constituted one end of a complete four-channel system.

As the carrier filter art developed, it was found practicable to utilize less frequency space for the individual channels. This enabled different frequency bands to be used for the opposite directions of transmission without materially raising the top frequency used. This had the advantage of simplifying the crosstalk problem and other interaction effects between opposite directed channels. In fact with the same frequencies used for both directions of transmission, crosstalk would have prevented more than one or two systems to be applied to a full 40-wire open-wire line. This would naturally have greatly restricted the application of the Type A system.

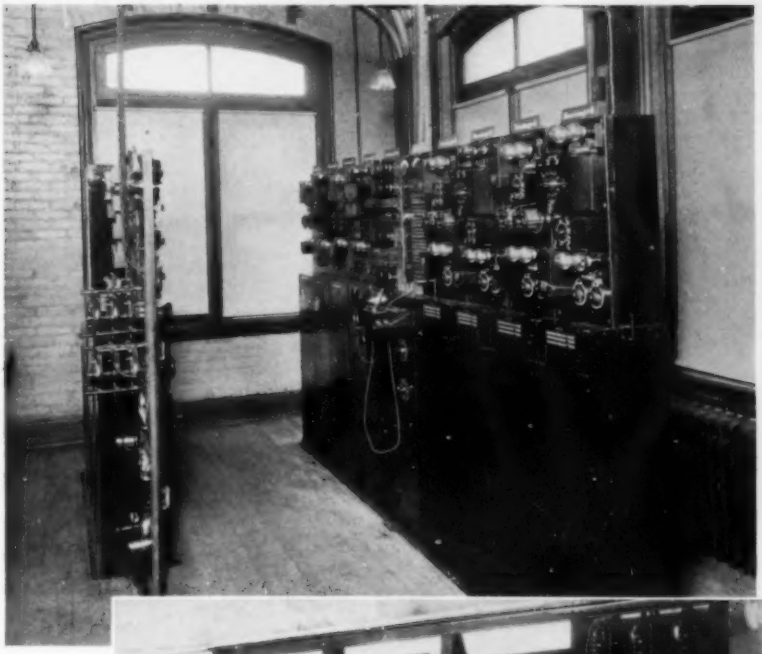
A few Type A systems had been installed to meet urgent service demands, but before any considerable number were placed in plant, a new design had been worked out embodying the new filter art. This new system was known as the Type B. It avoided balance problems and simplified the cross-talk problem materially by using different carrier frequencies in the two directions of transmission. This change permitted several systems to be operated on the same 40-wire lead although somewhat more frequent transpositions of the wires were required than had been the case with strictly voice frequency circuits. As noted in connection with Figure 3 it is necessary to supply to the demodulator a carrier current exactly the same frequency as that used in the modulator at the sending end of the circuit. In the "A" system this synchronization was accomplished by a separate channel but in the "B" system, in order to avoid the sacrifice of frequency space for this purpose, the necessary demodulator current was transmitted along with the voice currents for each channel. This latter plan, however, involved other disadvantages, the most important being that the load capacity of the repeaters and amplifiers in the circuit was materially reduced because of the necessity for amplifying these demodulator currents.

Figure 6 is a photograph of a B system installation. It will be noted in this picture that the trend toward relay rack mounting has had its effect and this system was mounted in this fashion. Four bays of relay space were required for one end of a complete three-channel system with its associated test panels.

## Advances in Carrier Design

Somewhat later, improvements in oscillator design made it practicable to dispense with the necessity of transmitting demodulator currents over the line. It became practicable to design oscillators which would maintain their frequency with only small deviations through the day. The next advance in

FIG. 5. COMPLETE 4 CHANNEL TYPE A CARRIER TERMINAL



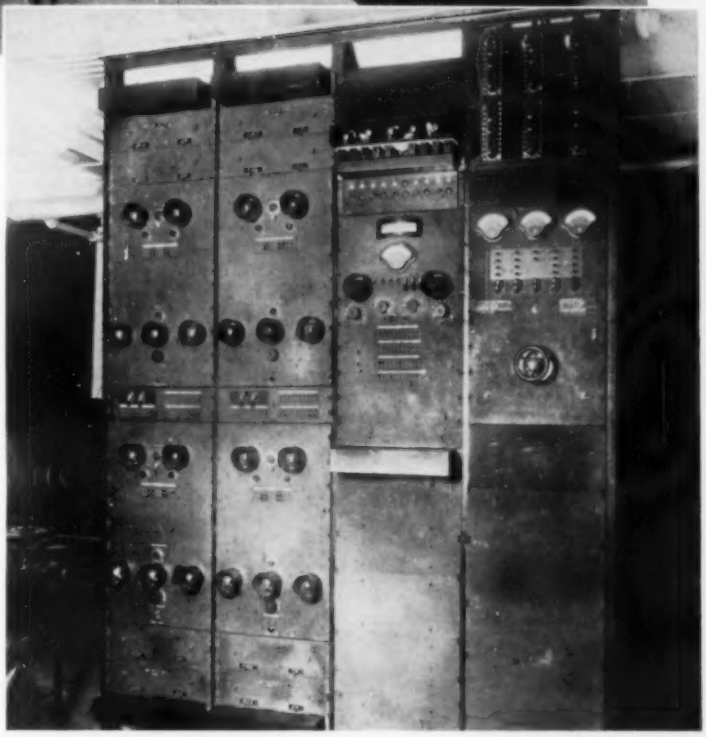


FIG. 6. COMPLETE 3 CHANNEL TYPE B CARRIER TERMINAL (INCLUDING SPARE CHANNEL)

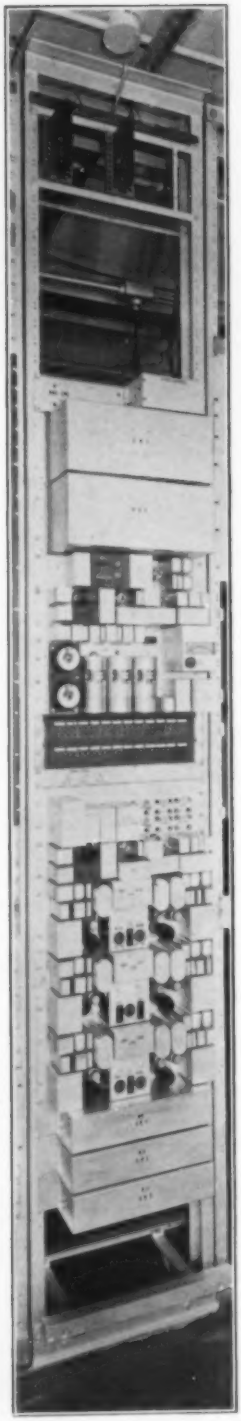


FIG. 7. NEW TYPE C CARRIER TERMINAL

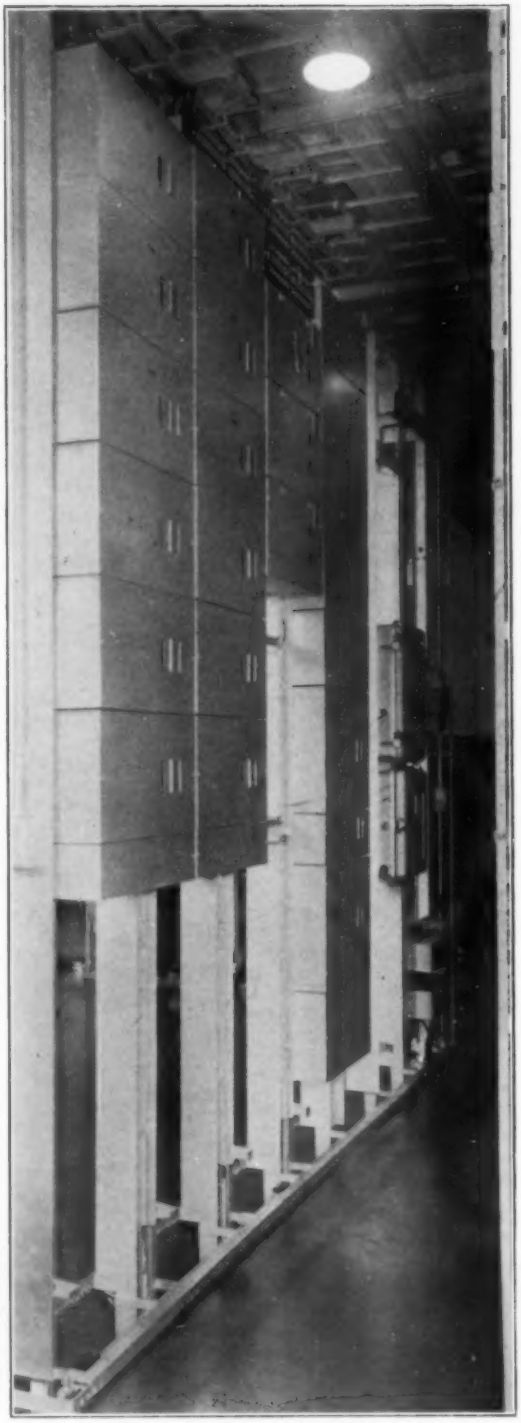


FIG. 10. TWO 12 CHANNEL TYPE K CARRIER TERMINALS

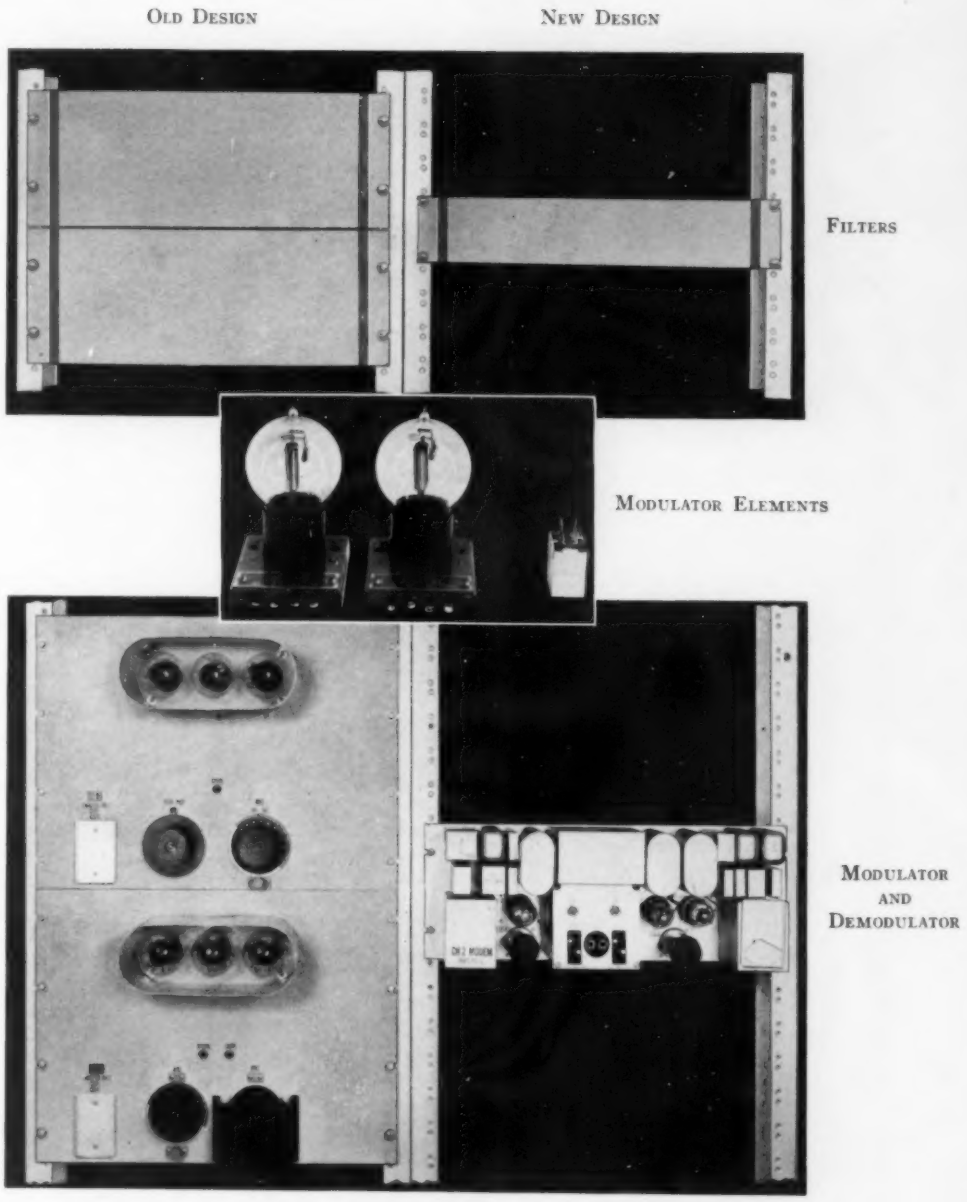



Fig. 8. Comparison of Elements of Old and New Systems

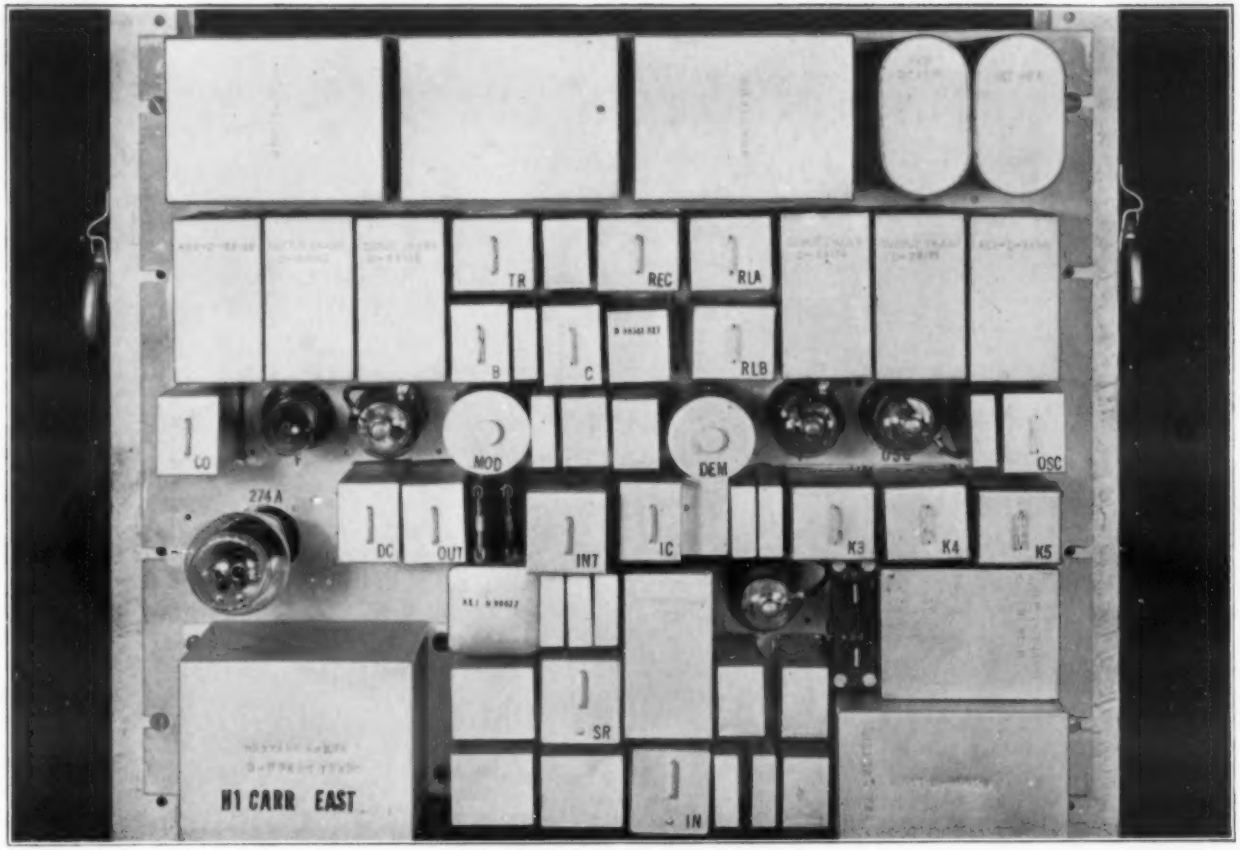



FIG. 9. ONE CHANNEL TYPE H CARRIER TERMINAL

carrier design, therefore, was to use separate oscillators at the two ends of the circuit and not transmit the demodulator current supply over the line. The Type C system which embodied this principle included oscillators whose design was sufficiently stable to permit only occasional frequency adjustments for synchronization purposes. Once per day was found to be adequate even in the early "C" systems.

The Type C systems for more than a decade have remained standard for use on open wire lines. Minor improvements have been made from time to time but the fundamental circuit and principles of operation remain the same. Figure 7, a photograph of an installation of the most recent Type C system, shows the reduction in size and complication which has been effected. The new system occupies only one bay of relay rack space as compared to three bays for similar systems manufactured 10 years ago. It is generally more efficient and more satisfactory than the earlier systems.

A striking example of the reduction in size which has occurred during the refinements of the C system is a comparison on Figure 8 of the filters used in the early systems and the filters used in the modern ones. It will be noted in the older design two filters occupied about fourteen inches of relay rack space, while in the new design two filters are mounted back to back and the entire vertical space for the two filters is only about 3½ inches. This makes a reduction of four to one in the relay rack space occupied by filters.

Another change which has recently been made tends to simplify and reduce the space required for a carrier system. This is the adoption of copper oxide modulators and demodulators in place of the former vacuum tube modulators. Figure 8 shows the relative size of the two vacuum tubes previously used in the Type C modulators and the copper oxide varistor unit which is now used for both modulators and demodulators in the modern Type C system. A complete modulator and demodulator with their associated input coils, etc., occupied a

space of 28 inches, while the copper oxide modulator and demodulator with their associated coils, etc., occupy only about 7 inches of relay rack space.

While carrier channels have usually been installed in units of three, there have been occasions where a lesser number of channels would be adequate and where the simplification of line problems involved with lower frequency transmission would be helpful. It is not generally economical to install a single channel of a Type C system, as a large amount of equipment is common to the several channels and the cost of the single channel would, therefore, be higher than necessary. Furthermore, it would not be practicable to take advantage of the possible economy in frequency band transmitted that should naturally result from a one-channel design. For these various reasons, therefore, a single channel system was developed utilizing the carrier frequencies immediately above the voice band and omitting many of the inherent complications of the three channel system. The most recent design of single channel system is known as the Type H. This system, pictured in Figure 9, occupies only about 16 inches of relay rack space—somewhat less than one-third of that used by the latest three-channel C system shown in an earlier photograph (Figure 7). These systems are frequently put in remote locations where no central office power is available for operating them and the panel therefore includes a power pack as an integral part of the system.

## Twelve Channel Systems

Also, work has been under way for several years on a new carrier system for open wire which will provide twelve more carrier channels in the frequency range above that used by the Type C systems. This new system is known as the Type J. Within the last few weeks, the first commercial installation has been completed between Dallas and San Antonio. Other sys-

tems are being installed and will be completed within the next few months. The added twelve channels requires the exploitation of frequencies as high as about 140,000 cycles. The basic modulating and demodulating units of this new system duplicate the Type K carrier cable channel units mentioned below but, of course, different arrangements are required for connection of these channels to the open wire lines. This extension of the frequency range puts a new burden on the design of the line circuits on which the carrier is superposed. Better transposition systems, new entrance cable arrangements, more attention to wire sag and many other changes are required in open wire engineering. The utilization of this new development work will mean that a forty wire open wire lead will have circuit possibilities greater than a full size voice cable designed a few years ago.

All of the above mentioned systems have been intended primarily for use on open wire lines. This fall the first commercial installation of a carrier system designed for long cable circuits is being put into service between Detroit, Michigan, and South Bend, Indiana. This new system is known as the Type K and provides 12 circuits on each two cable pairs equipped. Figure 10 is a photograph of a typical terminal installation of K equipment. The bay lineup shown includes 24 channel units and some miscellaneous equipment common to other channels not shown in the photograph.

Many practical problems were involved in the adaptation of the carrier art to cable construction. The rapidity with which the carrier currents diminish in strength as they pass along a cable pair requires repeater installations approximately every 16 miles as compared to the repeater spacing for voice circuits which is about 50 miles. The large number of repeaters in tandem on a given system requires many refinements of design so that the currents reach their destination without distortion. Changes of equivalent with temperature are so large that the problem of compensation becomes very complicated.

Crosstalk rapidly increases as frequency goes up and the elimination of crosstalk between the pairs carrying different systems, separated by only a fraction of an inch, was no easy matter. Complicated methods of neutralizing the crosstalk currents were developed so that frequencies up to 60,000 cycles could be utilized on existing types of cables. It was found impracticable, however, to operate systems in opposite directions in the same cable, so that two cables have to be made available for a cable carrier installation. The second cable on an existing route may be a small one, only including the number of pairs required for the return transmission of an equal number of carrier pairs in the existing cable. Where a new cable route is involved, two separate cables can be used, or where it seems economical two groups of conductors, each equivalent to a single small cable, may be located in the same lead sheath by use of a suitable shield between the groups of conductors.

The carrier art continues to advance and at the present time the Bell Telephone Laboratories are engaged in the development of a commercial carrier system involving frequencies in the million cycle range instead of around 100,000 or less. These new carrier systems must be operated on special conductors called coaxial units and open up an entirely new transmission technique. No installations other than the field trial between New York and Philadelphia have been made up to the present time, but it has been demonstrated on this trial that several hundred telephone channels will be practicable on a single unit of the coaxial type.

## Field of Use of Carrier Systems

In considering the economic field of application of carrier systems, it is hardly necessary to point out that in order to be used in place of other forms of construction, they must provide circuits at least as good as existing types and at a lower cost. The transmission objectives have been fully met in the latest

systems for they provide circuits of higher intelligibility and capable of being operated at lower net losses than any of the voice frequency forms of construction. By practically always operating on non-loaded conductors, transmission of the voice currents at a speed approaching that of light is attained.

It may not be generally realized that the speed of transmission becomes an important factor in the longer telephone connections. The actual elapsed time, together with a technical effect called "echo," may become very troublesome in carrying on a telephone conversation over a very long circuit. The higher speed of the new carrier circuits gives them a great advantage in this respect so that the factors mentioned are not important even in connections several thousand miles in length, such as might be involved when interconnecting two continents.

Economic balance comparisons of carrier and other forms of construction are, of course, made on an annual charge basis as investment in carrier equipment is usually much lower than in pole lines or cables, but the equipment carries a higher rate of annual charge. The figures applying to the carrier system must include not only the cost of the terminal equipment itself, but the cost of the intermediate carrier repeaters, any change in the voice circuits required by the superposition of the carrier, the expense of preparing the line for high frequency transmission including new transpositions, loading or other changes. Also, in some cases extra power plants have to be provided or existing batteries enlarged to take care of the added current drain imposed by the carrier apparatus.

Naturally on the short circuits the terminal represents the largest cost item and becomes a smaller proportion of the cost per mile as the circuits which they provide are lengthened. Therefore, the field of use for carrier is usually in connection with the provision of the longer toll circuits. In the early days of carrier, 250 miles was about the shortest distance where the annual charge comparison between the open wire carrier systems and other methods of providing the circuits would be

favorable to the carrier method. As development effort reduced the complexity of the carrier systems and cut down the equipment costs, the proving-in point continued to drop so that at the present time the three channel systems will frequently prove in for distances as low as 70 miles and single channel systems below 40 miles.

Of course, there were special cases even in the early days where three channel systems were proved in for distances much shorter than 250 miles. These cases involved special situations where the addition of wire on an existing lead would involve major reconstruction work or where a few carrier systems would postpone for a year or two the construction of a new line or the installation of a toll cable. For this reason, the figures mentioned above merely give a general indication of the field of use of these systems. J systems are so new that their field of use is not yet entirely clear. In open wire areas where sleet and other storm hazards are not severe they will probably have a large development particularly in providing the long through circuits. A good example of such development is the Fourth Transcontinental line, recently described in the QUARTERLY, on which several J systems will ultimately be installed.

The Type K carrier system which was developed for use on toll cables has an economical field of use for toll cable circuits over about 100 miles in length. It will probably have its greatest use in connection with the provision of relief along routes where at least one cable already exists. In case of a single cable route some of the pairs in the existing cable will be allocated to carrier use and a small size paralleling cable will be provided including only enough copper for the expected economical development of the K systems. Further additions of full size cables to existing cable routes will soon be the exception rather than the rule as was the case a few years ago.

Also, in many places, where new cables are to be installed, cables materially smaller than full size will be found economi-

cal. For instance, two one-quarter size cables or a half size cable divided in two parts by a shield for K operation will provide about 900 telephone circuits as compared to 225 circuits from a full size cable containing only voice frequency four-wire circuits. The new coaxial development will also provide circuits economically for distances of 100 miles or more and the exact line of demarcation between the field of use of the coaxial and K type of construction is not yet entirely clear. As experience with the two systems progresses, it is entirely probable that in many of our long haul cables of the future, particularly on routes having long through circuits, the coaxial system will play a large part.

## Typical Examples

The wide variety of carrier applications is shown by the following examples of the various types of carrier systems now

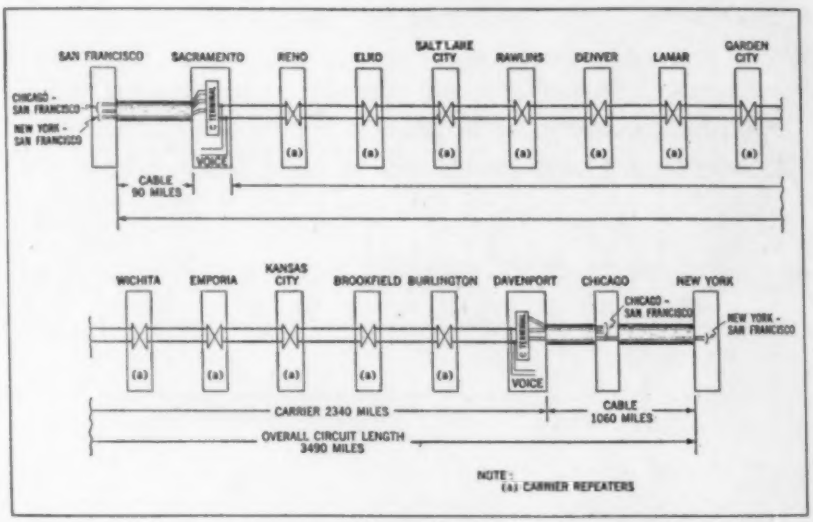



Fig. 11. Layout of Long Type C System

working in the Bell System plant. The longest type C carrier system in the United States at the present time forms part of

the New York-San Francisco circuits. The layout of this circuit is shown on Figure 11. It will be seen that there are two cable sections about 1130 miles in total length in which voice frequency four wire transmission is employed while the remainder of the circuit is formed by a channel of 2360 mile Type C carrier system. There are twelve intermediate carrier repeaters in this section and the amplification provided by these repeaters amounts to about 3,540,000,000,000,000,000,-000,000,000,000,000,000 times. This tremendous amount of amplification is required in order to restore the enfeebled currents to their original value as they travel across this long stretch of open wire line.

The shortest type C system now operating is one between San Pedro, California and Catalina Island. This installation is one where the open wire type of system has shown its adaptability to submarine cable construction and has been used to

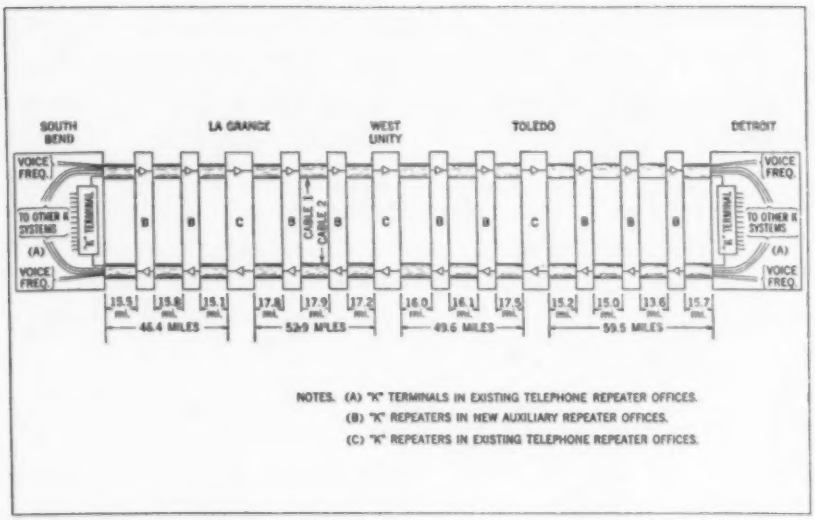



FIG. 12. LAYOUT OF FIRST COMMERCIAL TYPE K CARRIER INSTALLATION

defer expensive relief in this 30 mile underseas section for many years. In this case the standard Type C system has been

modified somewhat so that a total of twelve Type C channels are now operated over the two cables existing between these two points.

The layout of the first Type K carrier installation to be cut in commercial service is shown on Figure 12. It provides circuits between South Bend and Detroit, a distance of about 210 miles. In this distance there are twelve intermediate repeaters with an average spacing of about sixteen miles between repeaters. It is interesting to note that this close spacing of repeaters has required the construction of many new repeater stations, but all of the new repeater points between the terminal and the two existing voice repeater stations are operated from these existing stations so that the problem of providing and housing operating forces at each of the new points is avoided. This completed project is typical of the way that K systems will be used to relieve existing cable routes as the capacity of the present voice cables is reached.

As we look forward to future engineering of the toll plant in the United States, carrier systems will occupy an increasingly important position. Although about 20 per cent of our longer toll circuits are now supplied by carrier, another twenty years will probably see less than 20 per cent handled by other than carrier means.

ARTHUR F. ROSE

# World's Fairs and Bell System Exhibits

WORLD'S Fairs are community enterprises, promoted in the economic interest of some municipality but offering advantages to the larger units of state and nation; and their financial support classifies along similar geographical lines. The chosen site is usually entailed to some later public service, to serve as a park or university campus or, utilizing the more permanent buildings of the exposition, as a center for museums and galleries. Appeal is made, therefore, to local business organizations not only on the basis of goods and services to be sold but on the basis of wide public welfare. Bonds are sold to hotels, main-street stores, realtors, contractors, banks and public utilities—to those who may be expected individually to profit and to those who may be expected to contribute because of identification with the community.

Broadening its appeal, the exposition organization seeks appropriations from state and national governments and their support through the construction and maintenance of exhibits. From the industries which are national advertisers, and so expected to profit by any quickening of the financial pulse, it claims coöperation in the form of ground rents and exhibits. Every exposition, in addition to consuming in itself a certain amount of industrial output, serves as a general stimulant to business activity. The breadth and intensity of this effect depend upon the size, location and success of the exposition. The Chicago "Century of Progress" exposition of 1933, for example, which was boldly carried out during years of depression, has been generally credited with a favorable effect on business conditions.

Beyond the nation, representatives of the exposition solicit participation by foreign governments, although the extent to

which this is achieved, and hence the extent to which the exposition proves to be truly a world's fair, depends upon many factors, not the least of which are the political conditions of those countries and the concessions, such as free rent, that can be offered. Beyond these major groups, appeals for participation are made to organizations of all sorts, social, religious or educational; buildings are planned with space to be rented for exhibits of almost any size and of any publicly acceptable kind.

All these participants contribute to the educational program of the exposition, displaying their wares, accomplishments, ideals and services. Beyond them, however, is an almost equally large participation by concessionaires who provide visitors with food, drink, services and amusements. Between exhibit and concession sometimes only a fine line can be drawn; usually the criterion is whether or not there is something for sale and immediately deliverable.

In the United States, during 1939, there will be two world's fairs: at San Francisco, starting February 18, the Golden Gate International Exposition; and at New York, starting April 30, the New York World's Fair. The Bell System will be represented in both.

Mr. Gifford had already established a precedent for such participation in the case of two smaller expositions, one at San Diego in 1935, and one at Dallas in 1936. In each case the American Company arranged for the space and designed and erected a Bell System exhibit. The local operating company then undertook, at its own expense, the maintenance and operation. The division of responsibility seemed to work out very satisfactorily; the exhibits received innumerable compliments from visitors, and so also did the operating personnel for its courtesy and efficiency. This division, of course, followed the organizational relationship of the Bell System, exemplifying local responsibility for service backed by a national organization.

The exhibits at San Diego and at Dallas, and also the earlier exhibit at the Century of Progress Exposition in Chicago in 1933, were carried out under the general oversight of Vice President A. W. Page, of the American Telephone and Telegraph Company, in charge of public relations, and of Vice President F. B. Jewett, who is also the President of Bell Telephone Laboratories. To the Laboratories was delegated the conception and execution of the exhibits; and within that organization the responsibility was placed upon the writer and his associate, M. B. Long. This organization of responsibility has been continued for the New York and the San Francisco expositions.

At these two expositions of 1939 the Bell System should have a greatly improved exhibit because much has been learned from the crowd reactions at Chicago and also at San Diego and Dallas. At Chicago, it will be remembered, the two most popular exhibits were the demonstration of long distance telephony and the acoustical illusion of the dummy "Oscar" with his microphonic ears. Apparently the greatest public interest was attracted by exhibits which were either of striking scientific novelty or of a type which permitted individual visitors to participate, as did the demonstration telephone call. At San Diego, profiting by that experience, there was introduced the "hear-your-own-telephone-voice" equipment—now popularly known as the "voicemirror." This permitted a visitor to say a few words over a telephone and then immediately to hear those same words reproduced by a magnetic-tape recorder and so to learn how his voice sounds to others over the telephone. At Dallas another participating exhibit was tried out in the form of a hearing test. Eleven telephone booths were set up in a quiet space, where visitors could make tests of the acuity of their own hearing by listening to spoken words which gradually decreased in loudness until they were no longer audible. About two thousand individuals a day could be accommodated; and the exhibit ran to capacity.

When, therefore, Mr. Gifford agreed with the exposition managers to participate in the 1939 expositions there was a considerable amount of experience and a more or less complete philosophy of showmanship upon which to plan these exhibits.

Hundreds of possible exhibits have been imagined and critically analyzed. Most promising were those which met one or the other of the two criteria which previous experience had established. The first was the possibility of attracting participation by visitors in doing something of personal interest to themselves, using equipment and techniques of the Bell System. The second was scientific novelty, comprehensible to the general public. Novelty alone, however, was not considered sufficient. The exhibit had to be a direct outgrowth and adaptation of Bell System researches in electrical communication. It had to be an intriguing "stunt," such as a distinguished scientist might perform for the amusement of guests in his laboratory. "Oscar," for example, the popular dummy at Chicago, had been made possible by Bell System knowledge of speech and hearing and by its high quality instruments for picking up speech and for reproducing it at the ear of a listener. Similar, but not such striking, success had accompanied the "scrambled speech" exhibit at some of the earlier expositions.

To meet these criteria to the full, there had to be ruled out a number of exhibits which on first consideration were very attractive. For example, the manufacture and assembly of a telephone handset is an interesting operation which illustrates the complexity, delicacy and precision of telephone equipment, and also the manufacturing economies which accompany its production. Manufacturing operations, however, to be attractive to exposition visitors, should be spectacular, like the electrical welding of the body of an automobile. They should also be easily visible and very obvious, like the assembly-line operation of putting wheels on an automobile chassis. The assembly of a handset meets none of these requirements. Its parts are many and very small; and the reason for each of

them is highly technical. The public, also, usually takes most interest in the manufacture of products which it wears, eats, drinks, or smokes and, in general, of products which it buys on a competitive basis. A machine for knitting stockings would attract a much larger crowd than would an equally ingenious machine for covering telephone cords. For these and other reasons a number of possibilities were necessarily eliminated which at first thought might enter into a telephone exhibit.

A world's fair crowd, according to observations of the successful exhibits at other expositions, is one of great mobility, of short-lived interest, easily diverted and, in fact, demanding diversion. The whole atmosphere of flags, music, brightly colored buildings and transient crowds works against an exhibit which demands more than short timed attention. An exposition, by its very size and variety, calls for a quick "once over" rather than for the leisurely study which exhibits get in a museum or gallery.

The New York fair, for example, covers 1216 acres—partly water, but the shores given up to concessions and divertissements—of which the Bell System occupies slightly more than three acres.* The inevitable tendency for most visitors will be to move fast, to try to get all the way around and to "see what it is all about." If a conscientious visitor should devote his time to the various exhibits, restaurants and amusements upon the basis of the acreage they occupy and, in doing so, should spend a whole week, twelve hours a day, his proportionate time on the Bell System grounds would be only about thirteen minutes. Most out-of-town visitors, of course, will not stay long enough in New York to devote anywhere near that amount of time to the exposition†; but to meet the requirements of conversation in their home towns, they must have seen the major or most striking exhibits—the ones which everyone else

* 139,000 square feet.

† For strangers to New York City its many permanent attractions, its stores and theaters will be in competition with the Exposition. There are things in that city which are "musts" for visitors.

will mention on returning. They will have to travel fast, giving to most of the exhibits they pass only a limited survey. For that reason, a world's fair is not the medium for the inculcation of abstract ideas, but rather for publicising concrete things or acts, names and simple facts which he who runs may read.

No matter what exhibitors, themselves, may wish, the crowd always has a tendency to treat a world's fair like an amusement park, to look upon the entire thing as a show and to judge each exhibitor by the novelty, drama and attraction of the show which he puts on. Some of those who saw "Oscar" at Chicago and listened through his ears may not have understood the phenomenon which had amused them but nevertheless, along with others who could not even get a seat to listen, they went away to tell their friends, in substance: "when you go to Chicago don't fail to see Oscar at the telephone show."

From the standpoint of an exhibitor who wishes to give publicity to abstractions, to the principles underlying his product or to the philosophy of the service which he offers, such limited advertising possibilities might at first be somewhat disheartening. But that merely means that he must adapt his publicity to the medium which he is using. A large and successful world's fair offers a unique opportunity for publicity, but only if the advertiser will select from the messages which he wishes to deliver the one best fitted to the occasion. Visitors attend world's fairs with a willingness to be interested and impressed. For most of them a world's fair is a distinct event in their lives, which they remember for years; and a favorable impression once made has a permanence which does not usually accompany other forms of advertising. They do not, of course, remember the details; but the impressions stay with them and are disseminated by word-of-mouth to others who could not attend. The Columbian Exposition in Chicago during 1893, the St. Louis Exposition of 1904, the San Francisco Exposition of 1915, live in the memories of many of their

visitors; and for many the impressions that they there obtained of companies and products have been an unconscious influence ever since.

On the other hand, a world's fair is a community enterprise and exhibitors must enter it somewhat as a result of community spirit and as their contribution to the general welfare which the exposition is supposed to encourage. On that basis the exhibitor who puts on a good show, since that is what the public seems to expect, is credited with so doing, just as national advertisers on radio programs are credited with the musical or dramatic shows which they put on. Some of their listeners may turn down their loudspeakers when the announcers describe the products, but, nevertheless, all know that they are listening to and enjoying a performance supplied by a specific company; and all have a certain amount of gratitude to that company and some unconscious partiality for its products. For that reason a world's fair exhibit has some of the characteristics of radio broadcasting.

To put on a show which will appeal and attract, some exhibitors have to rely on orchestras, on marionettes, on vaudeville programs, on radio studios with costumed performers, or on similar amusements not directly related to their industries. The Bell System, however, is fortunate in that it can set up shows employing apparatus and techniques which are either adaptations of the equipment and methods which it employs in telephonic service or outgrowths of its acoustic researches. Acoustic developments are very suitable to a world's fair because when large shifting crowds are to be entertained an exhibit must be either big enough to be seen or loud enough to be heard.

Large crowds within the exposition gates are to be expected at both the 1939 fairs. Because of the much higher density of population within a reasonable transportation time of the New York site, its peak attendance, and also its daily average, should be higher than that of San Francisco. No one, of

course, can predict with accuracy, but certain figures can be cited as indicative. At San Francisco, because of its location on Treasure Island—filled land adjacent to Yerba Buena Island in San Francisco Bay—the maximum daily attendance is limited by available ferry slips and by the automobile capacity of the San Francisco-Oakland bridge to 400,000—according to some estimates to eighty or ninety per cent of that figure. At New York, plans for entrances, streets, and all the factors which affect traffic have been made for a peak of 800,000 or more. A million persons a day is, of course, not unprecedented at Coney Island or Jones Beach; and this estimate therefore does not appear out of line with possibilities.

What attendance is to be expected by an industrial exhibit, like the Bell System's, is even more difficult to estimate, but some facts stand out from the three recent expositions. First, it should be noted that the exposition gate, except for the opening day, always includes a variable number of "repeats" —of persons who have attended before. The writer remembers a citizen of Chicago who attended its 1934 exposition over sixty times. His family was away for the summer; the Black Forest restaurant served good food and offered an attractive floor show; so he ate dinner there instead of at a city restaurant. He, and others like him, treated the exposition admission as a cover charge for a favorite restaurant. Others repeated to accompany friends and out-of-town relatives whom they steered around to the exhibits that they "should see." The proportion of the total, or daily average, of gate attendance, therefore, which an exhibitor should expect involves some estimate of the proportion of "repeats." At Chicago in 1933 the Bell System exhibit had an attendance of about twenty-eight percent of the exposition gate. The peak was about 370,000 and on that day the exhibit was crowded by about 85,000 visitors—far more in fact than it could effectively accommodate.

Both New York and San Francisco introduce new factors into the problem of estimating attendance. At New York, for example, it is proposed to charge seventy-five cents admission instead of the fifty cents which has been the price at previous expositions. At San Francisco, although the admission is to be fifty cents, the transportation must either be by ferry or by automobile via a toll bridge and with a parking charge on the island. San Francisco will have the geographical advantage of a plot one third the New York size and correspondingly smaller distances to travel between exhibits. At New York the size is such that those who wish to give the exposition a quick once over will have to pay fares on the intramural buses. Neither of these situations is particularly favorable to the exhibitor who wishes his show to be seen, once at least, by as many individuals as possible. In both cases the minimum cost for a family promises to be about fifty percent higher than for previous expositions. If that proves to be a deterrent to members of the lower income groups it will result in fewer visits on their part and hence greater likelihood of their hurrying past many exhibits or missing them altogether. If that is so, it will work to the disadvantage of all exhibitors but particularly of those whose exhibits are small, poorly located or not sufficiently spectacular. It will discriminate in favor of those exhibits which early catch popular attention and are advertised by word of mouth.

The San Francisco fair will run for 288 days and the one at New York for 185. The longer run at San Francisco was undoubtedly set because of climatic conditions, starting dates for schools, and seasonal dates for Pacific coast tourists. In considering what these dates may mean to an exhibitor, it is necessary to distinguish between the number of different individuals who visit an exposition and the total crowd. Both expositions, of course, count very frankly upon a large repeat attendance from persons living in their immediate vicinity. The repeat attendance, however, is of less interest to an ex-

hibitor and of greater interest to concessionaires. Although it is impossible to estimate, one may assume that a definite but unknown number of different individuals will be effectively attracted by each exposition, and will visit it. The longer run—over a hundred days greater—at San Francisco means that those attracted by that exposition will have a larger number of days to choose for their attendance, and hence, other things being equal, their attendance per day will be smaller than it would if the run were shorter. That is predicated upon the assumption that in any season there are only about so many persons who will have time, money, opportunity and motive for attending an exposition which is located some distance away. If that is so, the peak crowd for which an exhibitor must plan will be less at San Francisco not only in proportion to the smaller total gate which is expected but also somewhat in proportion to this factor of a greater time distribution. In planning the Bell System exhibit at these two localities, therefore, handling a large crowd was considered much more of a problem at New York than at San Francisco.

At the two expositions the exhibits, with one exception, will be similar. But their capacity for individual participation and for observers will be markedly different. At New York the Bell System exhibit should be able to handle effectively five or six times as many visitors as at San Francisco.

The requirements of handling a large crowd, and the decision to design exhibits as far as possible for individual participation on the part of visitors, occasioned the development of a new principle for exhibit showmanship. This principle, which has controlled the display of the New York exhibits, can be briefly described as that of "a show within a show". An exhibit and its participants are arranged as a show for the much larger number who do not participate. It can be illustrated by the long distance demonstration. In an earlier form, this demonstration proved very attractive at Chicago and at Dallas. It will be enlarged and extended at New York. (In-

cidentally, a similar exhibit will appear at San Francisco.) At one end of a large room in New York there is a huge map of the United States, with switchboard lights marking the location of some 3500 important cities and towns. On either side of the map are booths from which, one at a time, the participants place their demonstration calls. In front of the map are tables with head receivers, where visitors can listen in and hear both sides of the conversation. Receivers are provided for a couple of hundred visitors. On the average, they listen for about five minutes, so that about 30,000 different listeners can be accommodated during a day. The actual participants in demonstrations will run about one every five minutes.

For each call the route is traced on a map by a line of lights. The crowd listening at head receivers in front of the map, the glass telephone booths for those who participate, the scheduling desk and the pages who guide the participants, the mechanism for selecting participants with its surrounding crowd—all these together form an interesting scene, the purport of which can easily be grasped by observers who do not participate. There will, therefore, be provided over the rear of this room a large balcony or mezzanine. Along this visitors can walk and look down upon the scene just described, in much the same way as visitors to the gallery of the New York Stock Exchange look down upon its milling brokers. Escalators and stairways, connecting the balcony with the main floor, allow those who wish to join in the participation to do so; but there will always be a large group which prefers only to look on. To call attention to the promptness with which long distance telephone connections are made, there are provided beside the map luminous clock mechanisms which indicate for each telephone call as it is made the time it takes. These timing devices show first the relatively small time it takes for the calling subscriber to pass his call to the operator; then the similarly small time until the distant subscriber's bell is rung; next the wait

until the called subscriber answers; and finally, what is frequently the largest part, the time to get the particular person who is called.

With this balcony arrangement, those who are taking part in the exhibit become a show for an even larger number of visitors. The balcony also is adapted to those who wish to travel fast. In addition, it will permit handling effectively about twice the crowd that could otherwise be handled and it will insure that each person who goes past the exhibit area is given some idea of what it all means. This principle, of course, follows the well-recognized psychology of the amusement park, where the crowd watching participants sliding down shoots or tumbling around on turning tables gets its amusement vicariously rather than by participation. Apparently, however, it has not generally been applied before to a world's fair exhibit, perhaps because few of the exhibits have been participating.

At New York, five of the six Bell System exhibits will be participating; and the sixth is to be a scientific novelty, the details of which are not yet ready to be announced. All the exhibits are essentially acoustic and each requires an acoustically treated room which is sheltered acoustically from adjacent rooms. Functionally, therefore, the exhibit building takes the general form of a series of six small theatres, with their foyers contiguous and, following the line of the foyers, a continuous balcony.

This principle of a show within a show will be particularly valuable in the case of the hearing test, where the participants pass through a glass-enclosed sound-proof room into inner rooms with special telephone booths for the individual tests. The tests are given through telephone receivers by a phonograph mechanism. This exhibit, therefore, would be almost meaningless and certainly uninteresting to those who do not participate if it were not for the possibilities introduced by the balcony. Over the booths, level with the balcony, and so

visible alike from the balcony and from the main floor, there will be what is in effect a small stage. This is equipped with microphone and public address system; and on it a demonstrator will explain what is going on in the booths. She will go through the motions of taking the test herself, but what she hears in her head receiver will be made audible through the loudspeaker to all those in that area. A test card like the ones the participants use will be shown on a large screen beside the stage, and it will be filled out appropriately as the loudspeaker reproduces the test. Because of the varying distances at which visitors will be from the loudspeaker, reproduction of the test will not give a measure of a visitor's hearing; but it will show him how hearing can be tested under the proper conditions in the sound-proof booths. It has, however, an added advantage in that those who are going to participate will have heard the explanation and listened to a sample test before going into the booths. This will make the hearing test almost foolproof and will increase very much the number of participants who can be handled per day. According to present estimates 14,000 individuals a day will be able to test their hearing.

The showmanship principle, for which the balcony is utilized, will be particularly effective in another acoustic exhibit, already referred to but not yet ready to be announced. This exhibit, which has the advantage of being participating and at the same time presenting a scientific novelty, is in effect an extension of the famous "Oscar show" in Chicago. It is designed for a very large number of observers and also for individual participation by seven or eight hundred persons a day. It requires a space of several thousand square feet and will be shown only at the New York fair.

At New York, in addition, there will be provided a "Hall of Telephone Pioneers." This is a continuation of the exhibit area of the building and is formed by a widening of the balcony. At its center there will be the voice mirror which proved attractive at Dallas. It will permit several thousand visitors a

day to hear how their voices sound to others when they telephone. Around the walls of this room will be static exhibits of equipment, historical and modern, of scientific or engineering significance to all interested in the progress of the communication arts. Adjacent to this hall is a small private room to serve as headquarters for Pioneers and as their meeting place.

The Bell System building at New York was functionally designed by Voorhees, Gmelin and Walker to house the exhibits which are being executed by the Bell Laboratories. The building stands on a triangular plot. Following the ideas of the architects, this site has been landscaped by Vitale and Geifert, and exterior panels and sculpture designed by Carl Milles, Hildreth Meiere and Edward Trumbull. Within the building the display of exhibits and the decorations are being carried out under the direction of Henry Dreyfuss. Acoustic treatment was engineered by Electrical Research Products Incorporated. Construction was undertaken by Vermilya-Brown Co. Inc., successors to Marc Eidlitz and Sons, acting as general contractors. When the building has been completed and its exhibits installed, the operation and management will be turned over to the New York Telephone Company, which will undertake that responsibility through its Long Island Area under the general supervision of its Vice President Carl Whitmore and the direct charge of Thomas W. Williams.

The San Francisco exhibit occupies one corner of the Palace of Electricity and Communication. This is one of the large high buildings erected by the Exposition, space in which is rented to various exhibitors for the construction of booths or small buildings. Neighboring exhibits in this Palace are those of General Electric, Westinghouse, Pacific Gas, Western Union, General Cable, International Business Machines and others. The plot occupied by the Bell System is by a few hundred square feet the largest in the building. It fronts on the main aisle, opposite space rented by General Electric. On this aisle there are two entrances to the Bell System structure; but it

also has the peculiar advantage, so far as concerns flow of traffic, of its own entrance from the outside court which adjoins the Palace. The exhibit structure is being built by Lindgren and Swinerton, Inc., of San Francisco, who constructed the Montgomery Street headquarters building of the Pacific Telephone and Telegraph Company. After the installation of equipment, which is being built in Bell Telephone Laboratories, operation and management of the exhibit will be handled by the Northern California Area of the Pacific Company under the general supervision of Vice President M. R. Sullivan and the direct charge of L. N. Roberts.

JOHN MILLS

# Notes on Recent Occurrences

## PRESIDENT GIFFORD IS ELECTED HEAD OF THE TELEPHONE PIONEERS

PRESIDENT WALTER S. GIFFORD of the American Telephone and Telegraph Company was elected President of the Telephone Pioneers of America for the year 1939, at the seventeenth annual meeting of the General Assembly of that organization, which was held in Toronto, Canada, on September 30 and October 1, 1938.

## DR. JEWETT TO RECEIVE JOHN FRITZ GOLD MEDAL

FRANK B. JEWETT, Vice President of the American Telephone and Telegraph Company and President of the Bell Telephone Laboratories, has been awarded the John Fritz Gold Medal, highest of American engineering honors, for 1939, for "vision and leadership in science, and for notable achievement in the furtherance of industrial research and development in communication." The award is made by a board composed of representatives of the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

Among other distinguished scientists who have been recipients of the John Fritz Medal have been Alexander Graham Bell, John J. Carty, former Chief Engineer and later Vice President in charge of Development and Research of the American Telephone and Telegraph Company, Lord Kelvin, Guglielmo Marconi, and Thomas A. Edison.